JUNE, 1952

PETROLEUM REFINER

SPECIALIZED FOR REFINING, NATURAL GASOLINE, AND PETRO-CHEMICAL ENGINEERING, OPERATION AND MANAGEMENT

We like Lagonda
THE OVERWHELMING MAJORITY of the men who do the work, acclaim LAGONDA for still tube cleaning. They know through personal experience that LAGONDA handles easier, doesn't quit on them, gets through quicker. That's what they want in a tube cleaner.
So it's LAGONDA for a clean sweep, in performance as well as in popularity. Why not look at the record—Bulletin Y-29, on request.
ELLIOTT Company
LAGONDA DIVISION • SPRINGFIELD, OHIO
Plants at: JEANNETTE, PA. • RIDGWAY, PA.
AMPERE, N. J. • SPRINGFIELD, O. • NEWARK, N. J.
DISTRICT OFFICES IN PRINCIPAL CITIES

puts the HEAT on heat exchangers

By changing to Yarway Impulse Steam Traps, an oil refinery reports much hotter steam in their heat exchangers **—plus two other important extras:**

(1) They were able to operate the plant with 6 boilers instead of the 8 formerly required.

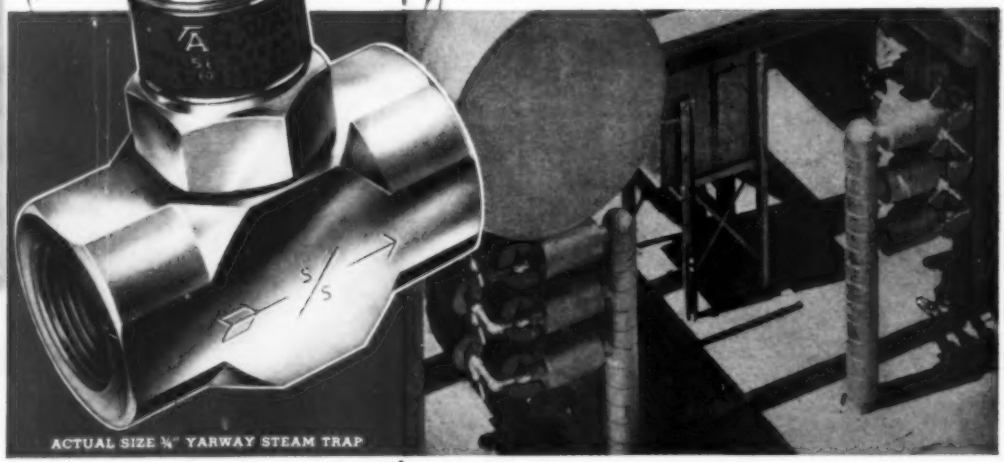
(2) Three men formerly required to service old-type traps can now be used for productive work.

Significant sidelight—these Yarway traps are operating under severe conditions, many outdoors with temperatures often below zero.

Plant after plant is standardizing on Yarway Impulse Steam Traps because Yarways are designed to deliver the most premium B.T.U.'s at top temperatures into your process or product. **They get equipment hotter, sooner . . . and keep it hot.**

Other reasons—small size, easy installation, good for all pressures, only one moving part, low maintenance, low price.

Buy your Yarway Impulse Steam Traps from the nearest of 216 distributors. For name, write us.



ACTUAL SIZE ¾" YARWAY STEAM TRAP

YARNALL-WARING COMPANY
128 Mermaid Ave., Philadelphia 18, Pa.

FREE OFFER. Don't take our word for it. Test Yarway's advantages in your own plant, without cost or obligation. Drop us a card or letter—a trial trap will be delivered promptly.

YARWAY the steam trap

designed with more production in mind

PETROLEUM REFINER

Specialized for Refining, Natural Gasoline and Petrochemical Engineering, Operation and Management

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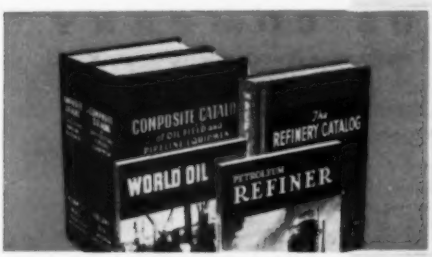

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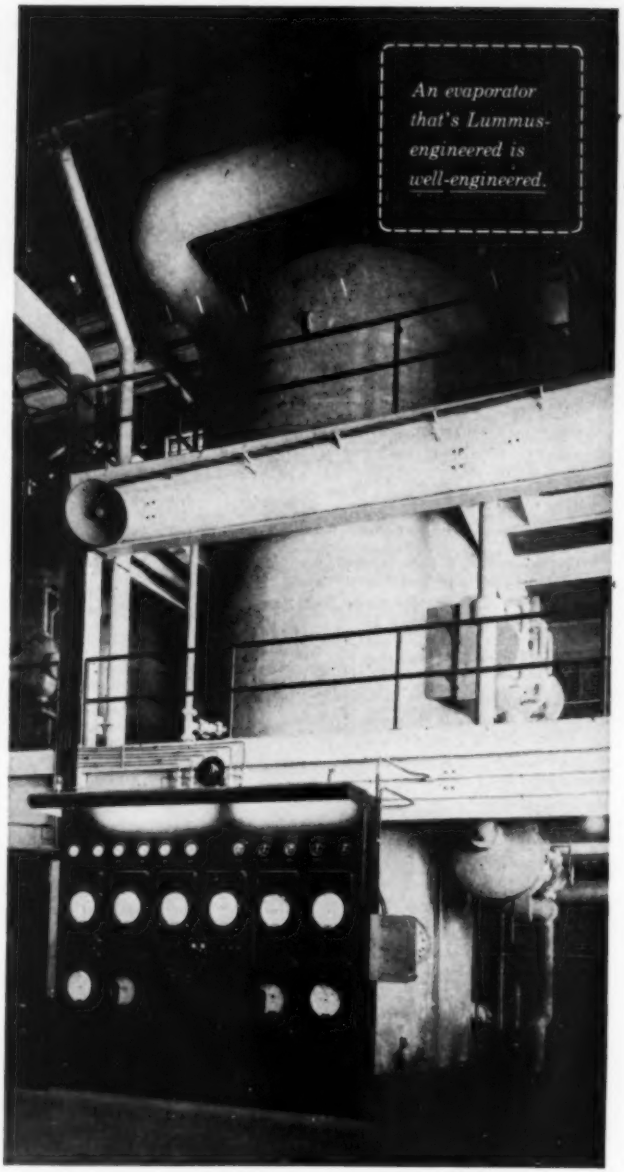
This triple effect evaporator gives three-fold savings

General Electric Company is recording unusual economies in the amount of generating steam required to run its Pittsfield, Mass. power plant. A heavy contributor to these savings is the Lummus-designed-and-built evaporator pictured here.

This triple effect vessel really wrings maximum efficiency out of exhaust steam. Employing three effects (or stages) of evaporation—all built into one shell—the unit produces about 140 gpm of high purity distilled water, at a consumption of approximately 20,000 lb./hr. of 1.5 psig steam and 100 gpm of city water. With a sharp eye to practical aspects, Lummus designed the unit so that hot "liquor" is dumped from one effect to the other, thus minimizing heat make-up. And when the third phase is completed, all but 4 gpm of original feed water is vaporized.

The vertical, three-compartment unit is 30′6″ high x 10′6″ dia. Each effect contains a removable tube bundle of 956 tubes, ¾″ O.D. x 9′0″ long. Other components completing this all-Lummus installation are: a 1500 sq. ft. surface condenser, a feed water pre-heater, and a two-stage steam jet air ejector complete with a single inter-after condenser.

Three years in service, the Pittsfield job shows a degree of performance that's not at all unusual when you're talking about Lummus equipment. That's why it will pay you to give *your* next heat transfer job to Lummus.



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HEAT EXCHANGER DIVISION

THE LUMMUS COMPANY

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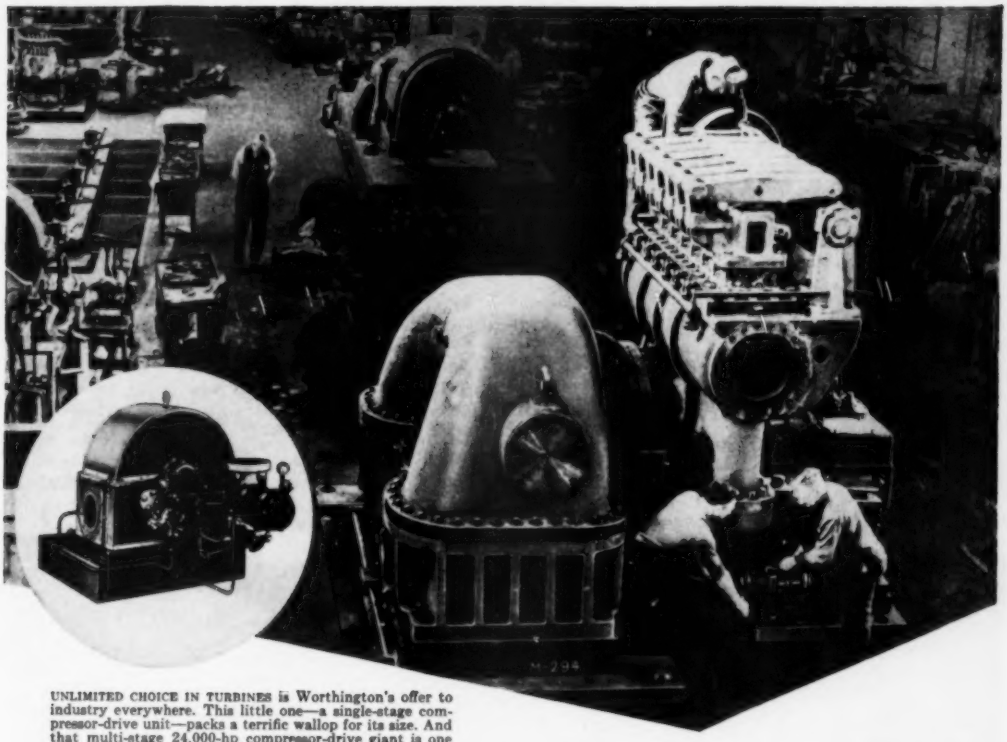
Steam Surface Condensers • Evaporators • Extraction Bleeder Heaters • Steam Jet Air Ejectors • Steam Jet Refrigeration • Barometric Condensers • Heat Exchangers for Process and Industrial Use • Process Condensers • Pipe Line Coolers.



UNLIMITED CHOICE IN TURBINES is Worthington's offer to industry everywhere. This little one—a single-stage compressor-drive unit—packs a terrific wallop for its size. And that multi-stage 24,000-hp compressor-drive giant is one of the largest ever built for this type of service.

Single-stage midgets to multi-stage giants

Whether your turbine requirements call for the biggest or the smallest—straight condensing . . . straight non-condensing . . . extraction . . . mixed pressure extraction . . . low pressure . . . high back pressure . . . for mechanical or generator drive . . . with governors for constant or variable speed—*Worthington has an answer.*

Each Worthington turbine is designed to make the steam do *more* work, so you save power and money throughout its long life.

Learn more about Worthington turbines. Get the facts on why *there's more worth in Worthington* by writing to Worthington Corporation, formerly Worthington Pump and Machinery Corporation, Steam Turbine Division, Wellsville, N. Y.

T.2.2

A GREAT TEAM IN STEAM

WORTHINGTON

Steam Turbines

What one analysis gives you maximum tube life per dollar? Ask the experts!

This month's report is on: **SICROMO 3**

Has high degree of surface stability under oxidizing conditions up to 1200°F. Excellent oxidation resistance and good corrosion resistance. For use in cracking furnaces, heat exchangers, hot oil lines, superheaters, and for forgings and other parts exposed to oxidation or oil corrosion.

23 TIMKEN® STEELS FOR HIGH TEMPERATURE SERVICE

Carbon	Sicromo 2	Sicromo 5S	16-13-3
Carbon-Mo.	Sicromo 2½	Sicromo 5MS	25-20
DM-2	2½% Cr.-1% Mo.	Sicromo 7	25-12
Silmo	Sicromo 3	Sicromo 9M	35-15*
DM	4-6% Cr.-Mo.	18-8 Stainless	16-25-6*
2% Cr.-Mo.	4-6% Cr.-Mo.-Ti.	18-8 Cb	

*Not available as seamless tubing at the present time.

ONE and *only* one analysis of high temperature steel tubing can give you maximum tube life per dollar under a particular set of heat, pressure, corrosion and oxidation conditions.

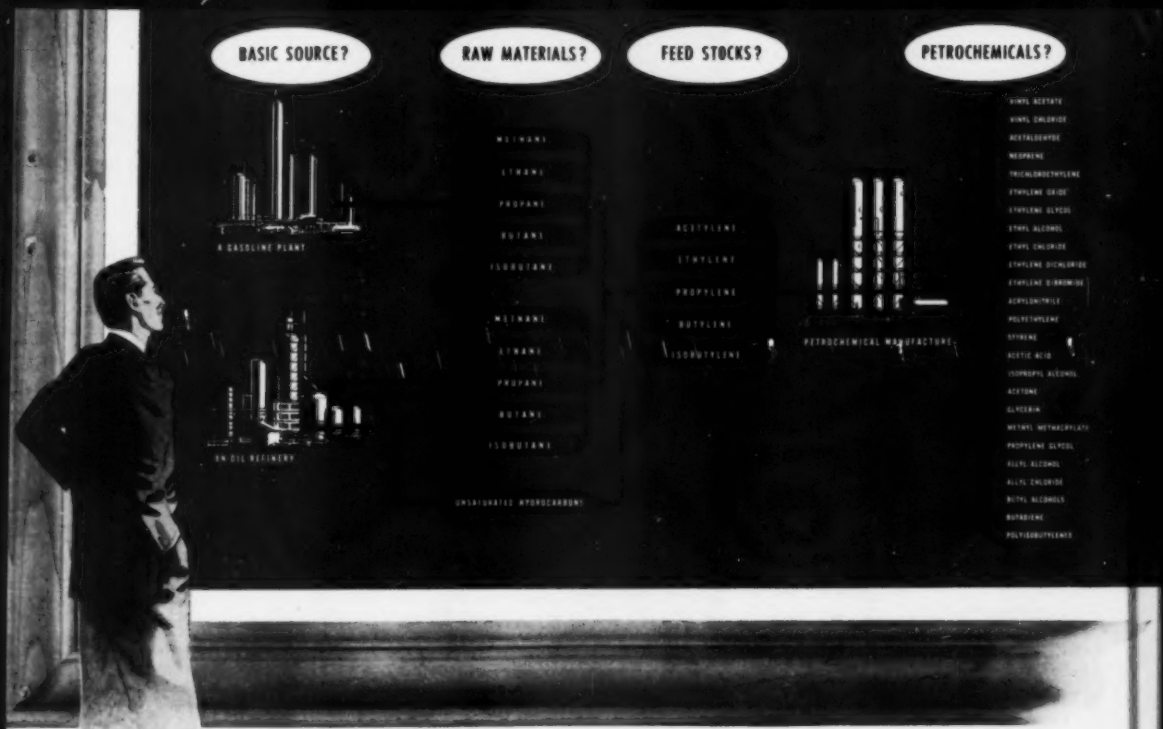
The Timken Company's metallurgists are recognized authorities on high temperature steels. Backed by more than 20 years research and with 23 different analyses to choose from, they'll help you select the one steel that will give you the best life/cost ratio. And no matter which analysis you select, you can be sure of uniform quality, because the Timken Company controls quality from melt shop through final inspection.

Let our "RSQ"—Research, Supply, Quality—solve your tube problems. *Ask the experts!* The Timken Roller Bearing Company, Steel and Tube Division, Canton 6, Ohio. Cable address: "TIMROSCO".

Timken high temperature tubing must pass many rigid inspections. Pictured above is the cooling bed where powerful lights permit careful inspection of the inside surface of Timken high temperature tubing.

YEARS AHEAD—THROUGH EXPERIENCE AND RESEARCH

SPECIALISTS IN FINE ALLOY STEELS, GRAPHITIC TOOL STEELS AND SEAMLESS TUBING



Where do you fit in this petrochemical picture?

Currently engaged in this highly specialized work, Fluor can help determine your potentials in this rapidly expanding industry.

Petrochemicals, the largest new factor in our ever-expanding world of chemicals, now account for nearly one-quarter of all U. S. chemical production. Despite this, it is estimated that only one-half of one percent of all present oil and gas production is being utilized as petrochemical feed stock. This opens up new opportunities for the oil and gas producer and investor.

If you own, operate, or have interests in an oil refinery or a gasoline plant, you should be aware of *your* potential as a supplier of petrochemical raw materials. This is particularly so when it is considered that the increase in value of an end petrochemical product may easily be four or five times greater than that of normal products realized from other hydrocarbon processing operations!

Let Fluor assist you...

The proven abilities to design, engineer and construct complete plants and facilities for the petroleum, natural gas and petrochemical industries have established The Fluor Corporation as one of the nation's major engineering and construction organizations.

One call to Fluor will place men with broad and diversified experience in petroleum and chemical engineering technology and economy at your disposal. Let Fluor put these talents and facilities to work for you. You will be sure with Fluor!

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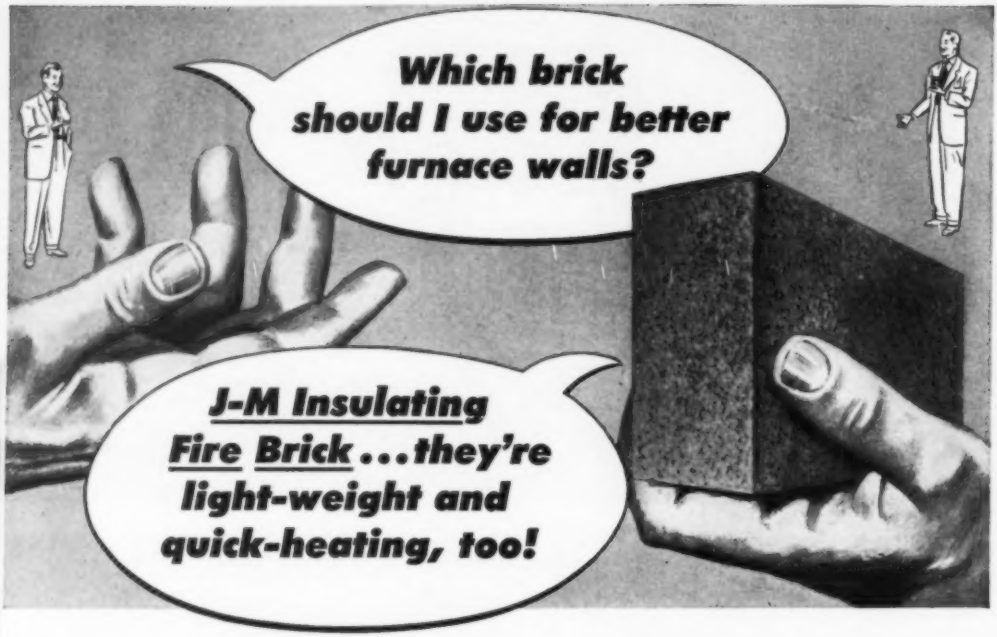


6 types . . . for savings in services up to 3000F

Because of their quick-heating and low-heat transfer characteristics, Johns-Manville Insulating Fire Brick are efficient fuel-savers for use at operating temperatures up to a full 3000F on the insulation.

Each type of J-M Insulating Fire Brick has the correct balance of thermal and physical properties that assures maximum economies within a specific temperature range. All types are *quick-heating* . . . operating temperatures are reached in a short time, thereby saving fuel.

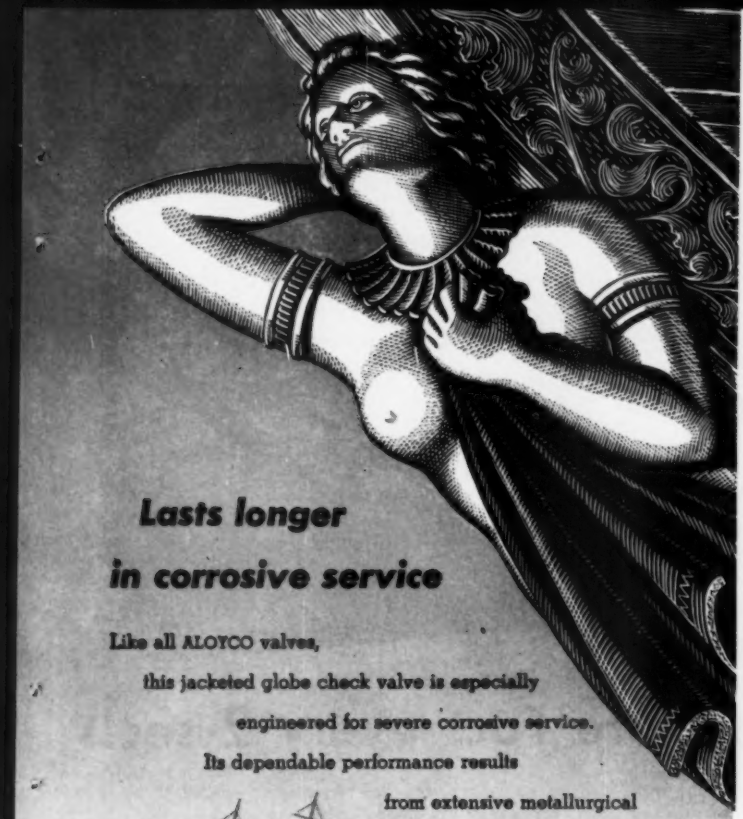
Identical materials can also be obtained in large size units known as Johns-Manville Insulating Fireblok. Fireblok have the same properties as the brick, but are made in extra large sizes for added construction economies. The large units can be installed faster . . . require fewer joints and less bonding mortar. During rebuilding or repair, furnace down-time is appreciably shortened with Fireblok construction.

A Johns-Manville insulation expert will gladly explain the advantages and economies of using J-M Insulating Fire Brick and Fireblok for refractory linings or as back-up insulation behind other refractory protection. Write to Johns-Manville, Box 60, New York 16, N. Y. In Canada, write 199 Bay St., Toronto 1, Ontario.

Properties	Types of Insulating Fire Brick and Fireblok					
	JM-3000	JM-28	JM-26	JM-23	JM-20	JM-1620
Temperature limit	†3000F	†2800F	†2600F	†2300F	†2000F	‡2000F †1600F
Density, lb per cu ft	63–67	58	48	42	35	29
Transverse strength, psi	200	120	125	120	80	60
Cold crushing strength, psi	40	150	190	170	115	70
Linear shrinkage, percent	*0.8 at 3000F	4.0 at 2800F	1.0 at 2600F	0.3 at 2300F	0.0 at 2000F	0.0 at 2000F
Reversible thermal expansion, percent	0.5–0.6 at 2000F	0.5–0.6 at 2000F	0.5–0.6 at 2000F	0.5–0.6 at 2000F	0.5–0.6 at 2000F	0.5–0.6 at 2000F
Conductivity (Btu in. per sq ft per F per hr at following mean temperatures)						
500F	3.10	2.00	1.92	1.51	0.97	0.77
1000F	3.20	2.50	2.22	1.91	1.22	1.02
1500F	3.35	3.00	2.52	2.31	1.47	1.27
2000F	3.60	3.50	2.82	2.70	1.72	....

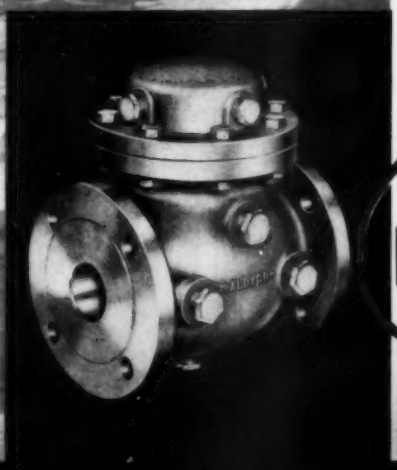
*24-hr Simulative Service Panel Test; all others 24-hr soaking period. †Back-up or exposed. ‡Back-up only.

JOHNS MANVILLE JM PRODUCTS **Johns-Manville** *first in* **INSULATIONS**



Lasts longer in corrosive service

Like all ALOYCO valves, this jacketed globe check valve is especially engineered for severe corrosive service. Its dependable performance results from extensive metallurgical research and production of high alloy valves exclusively.



ALOYCO No. 1505 Jacketed Check Valve has a cast-in heating chamber or jacket on both body and cap which enables all parts to be uniformly heated.

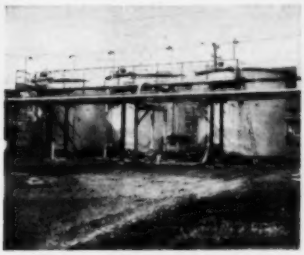
When you're recovering sulfuric acid you need corrosion-resistant valves!

The recovery of sulfuric acid from waste oil refinery sludges represents tough service life for valves.

That is why so many ALOYCO corrosion-resistant valves are in use at this acid sludge recovery plant of the Bayway Refinery of the Esso Standard Oil Company.

In the Chemico (Chemical Construction Corporation) sludge conversion process which is used here, acid sludge is heated to about 550F where it decomposes into sulfur dioxide gas, solid coke, water vapor and a small quantity of hydrocarbon vapor. The sulfur dioxide gas is then processed in a contact sulfuric acid plant to produce clean sulfuric acid of any desired strength.

Whenever valves are exposed to such severe corrosive influences as sulfuric acid, maintenance-free service and long life is of the utmost importance.



At the Bayway Refinery of the Esso Standard Oil Company, recovered sulfuric acid of any desired strength is stored waiting use in the refinery.

ALOYCO valves are made of high alloys engineered to counteract specific corrosives. That is one reason more ALOYCO valves are used than any other brand.

Such alloys are under constant study in ALOYCO's metallurgical laboratory, the largest ever devoted exclusively to the diagnosis and treatment of corrosion-resistant valves.

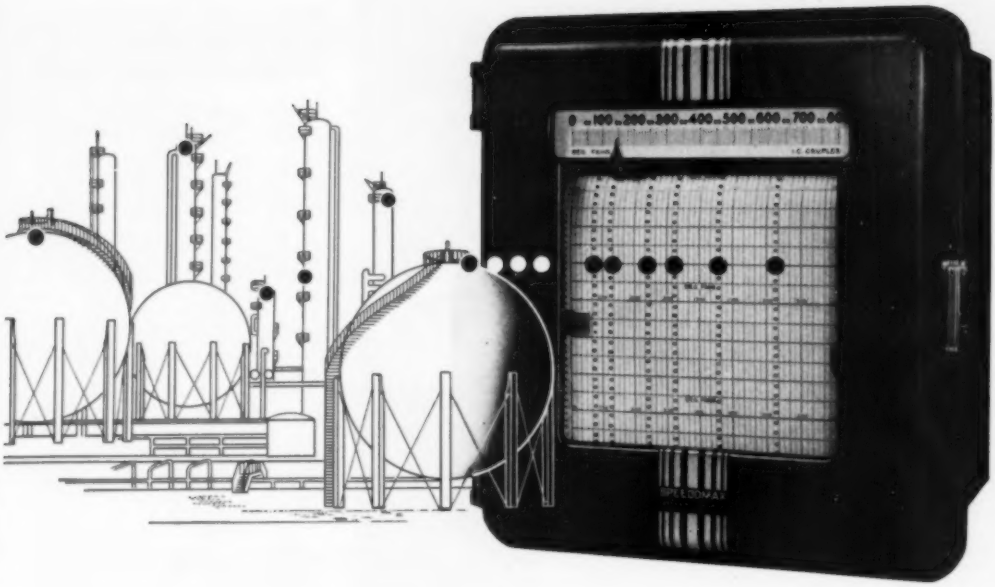
If your plant deals with severe corrosives or must guard against product contamination, let the *Aloyco Department of Corrosion Analysis* help you solve your problem with ALOYCO valves.

ALLOY STEEL PRODUCTS CO., INC.
1303 West Elizabeth Avenue, Linden, N. J.

Longer Lasting

ALOYCO VALVES

1st in Corrosive Service



A new temperature Fact every 2 sec!

Today, when many refinery operations may need temperature facts within seconds instead of minutes, the Speedomax story is worth knowing:

For a Speedomax Multiple-point instrument's record-printing "wheel" darts from temperature to temperature in just 2 seconds per point! Thus, if there are, say, 15 fairly important temperatures on a single refinery unit, each one can actually come up and be recorded as often as twice per minute, automatically and continuously.

Two extra checks for vital temps

But suppose a few points require even closer watching, or more frequent recording? Speedomax handles them, too, in either of two ways:

First, they can be recorded more frequently than the other points, in such a sequence as 1, 2, 1, 3, 1, 4, etc.

Second, the vital points can be recorded in greater detail than the other points. This is done by giving the instrument an additional range which is used only with the pre-selected points. This range puts far fewer degrees-per-inch across the instrument's scale; it thus "spreads" the reading for detail.

Ability to measure temperature from any source and across either wide ranges or the new narrow ranges is another L&N specialty. Selection among thermocouples, Thermohms and Rayotubes will determine the correct sensing element. Selection among various recorder components will put the information on paper in the desired form.

160 temps on one instrument

For these and many more features . . . for instance, 160-point models . . . credit Speedomax's refined, stable, dependable construction, both electrical and mechanical. Too, Speedomax is not affected by vibration; never needs levelling up; can measure many quantities besides temperature.

Any L&N office, including 4923 Stenton Ave., Phila. 44, Pa., will send the Speedomax story on request.

LEEDS NORTHRUP

Jrl.Ad. ND46-709(2)

Those who buy goods or services bearing the marks of well-known organizations such as those shown here, do so with understandable confidence. And *every one* of these representative leaders in American industry has expressed *its* confidence in Zallea Expansion Joints by *buying* them not only once, but by issuing repeat orders!

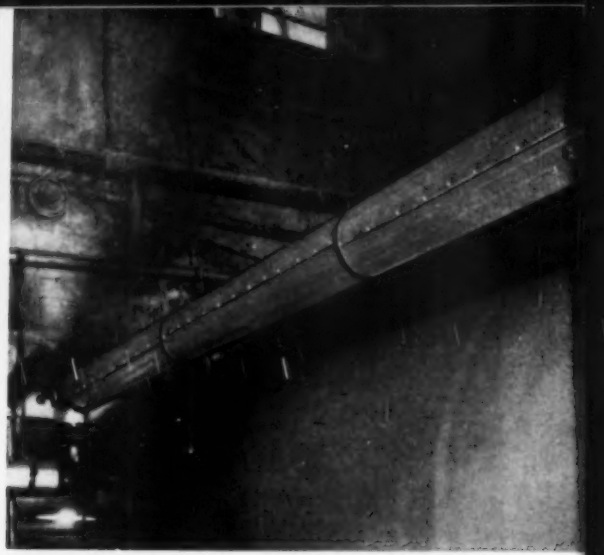
Would you be interested in knowing why we enjoy this nationwide preference? The answer is easy. It is because the value in an expansion joint is in direct proportion to the length of trouble-free service life. The records prove that Zallea Joints stand-up where others fail.

There is a Zallea Stainless Steel Expansion Joint for every service need—in diameters from 3″ to 30′0″—pressures ranging from vacuum to 2000 psi—and temperatures from sub-zero to 1600° F. For full details regarding your expansion joint problems or requirements, just get in touch with us. Zallea Brothers, 890 Locust Street, Wilmington 99, Delaware.

Catalog 47 and Bulletin 351 describe the complete line of Zallea Expansion Joints and Flexible Connectors. Write for a copy today.

Zallea
EXPANSION JOINTS

IN PETROLEUM REFINERIES like this a new kind of aluminum jacketing is used to protect the insulation on hot and cold lines. It is known as Childers Aluminum Jacketing and is especially engineered to combine the long life and weather resistance of aluminum with a low first cost. It goes on quick and easy—can be used and re-used. It is made of tough but flexible .006" 35 aluminum alloy, so it handles easily and requires no shop forming.

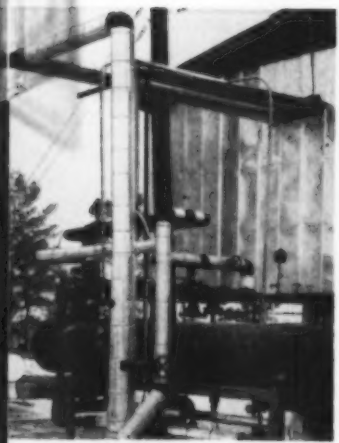


IN CHEMICAL AND PAPER plants: engineers are finding new uses for this easy-to-handle jacketing. Childers Jacketing here is in use at Scott Paper Company's tremendous Chester, Pa., plant. The insulated line passes between fast moving rolls carrying the felt used in paper making both above and below the line. The Aluminum Jacketing protects against paper dust and water, both of which are always present in the manufacture of paper. The jacketing also appreciably diminishes the possibility of the spread of fire which might strike across ordinary canvas jacketing.

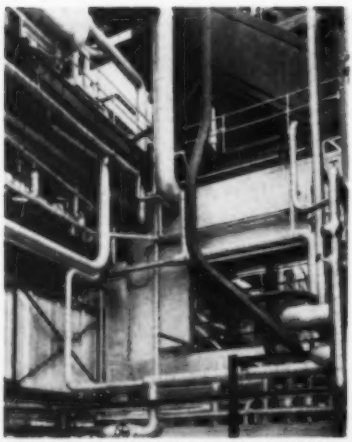
Engineered for outdoor lines — new, low-cost aluminum jacketing now used in 567 processing plants

The new kind of aluminum jacketing for insulated lines shown in the pictures on this page is Childers Aluminum Weatherproof Jacketing. Write for samples and full details, no obligation. Childers Manufacturing Co., Dept. PR-10, 3620 W. 11th St., Houston 8, Texas.

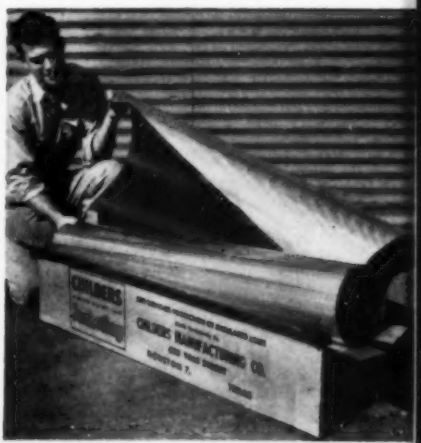
Under CMP regulations, Childers is a Class B product, the use of which is not restricted.



IN FOOD PROCESSING plants such as this Minute Maid Corp. unit at Plymouth, Fla., Childers Jacketing is useful for both indoor and outdoor installations. Its clean, shining appearance and ease of washing are extra advantages.

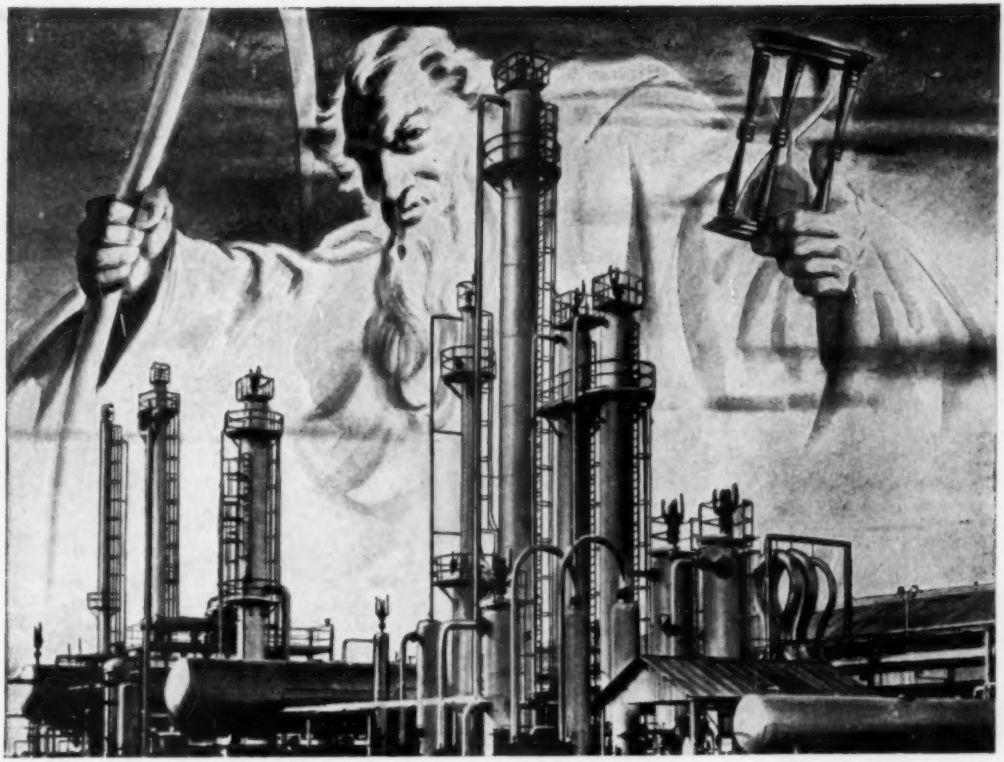


IN POWER PLANTS—indoors and out—Childers Jacketing is an ideal material for protecting insulation. This is a big outdoor installation in the South. This jacketing needs no painting, and the gleaming aluminum surface makes for "good housekeeping" in any utility or institutional power station.



ALMOST ANYWHERE you have insulated lines in your processing plant, consider this specially engineered jacketing. It is flexible, easy-to-handle; yet it has the appearance values and the weather resistance that are inherent in aluminum. Write to address shown above for full details.

Advertisement



Since 1929, A. O. Smith has been helping the petroleum, Petro-chemical, chemical and paper industries solve many of their difficult corrosion problems.

The Ultimate JUDGE is TIME

Smithlined vessels have been in continuous corrosive service for over 20 years without failure of the lining attachment or the vessel itself.

This history of service is significant. It confirms the findings of our own research laboratories and supports the designs of our engineers, that closely controlled resistance-welding of stainless or other corrosion resistant liners to carbon steel vessel walls is the best means of providing long-term service and satisfactory performance under specific corrosion, pressure and temperature conditions.

If you have a corrosion problem, let A. O. Smith work with you in solving it. Our engineers and laboratories have an unequalled background of experience and data gained from hundreds of successful applications of Smithlining. Contact our nearest district office.

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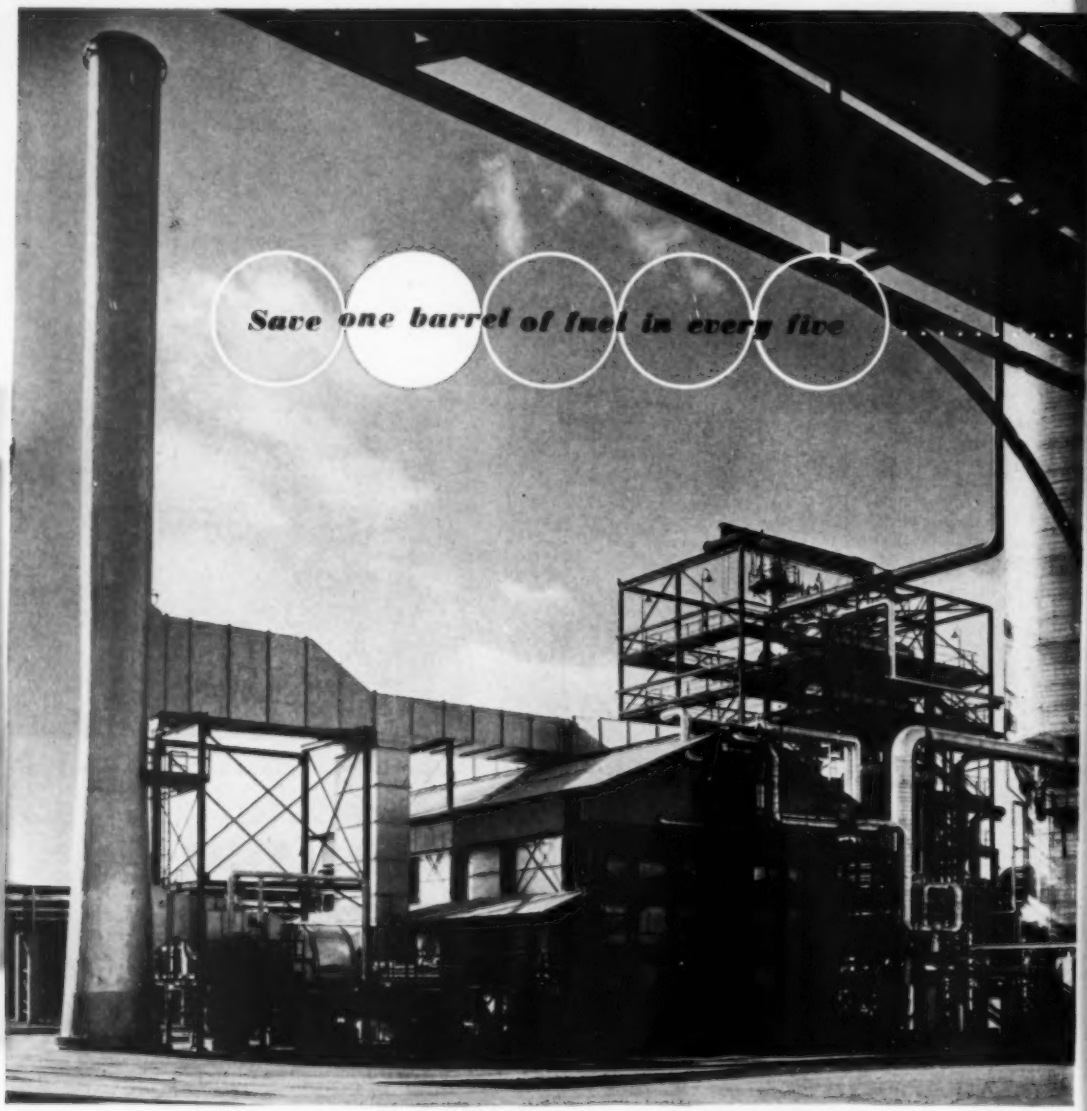


Crude heater at Continental Oil Company, Ponca City, Oklahoma, using a Ljungstrom Air Preheater.

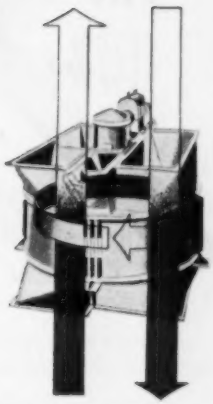
Refineries Now Using the Ljungstrom Air Preheater on One or More Process Units . . .

Continental Oil Company
Humble Oil & Refining Company
Interocean Oil Company
Le Conselho Nacional de Petroleo Ref.
Lion Oil Company • Ohio Oil Company
Richfield Oil Corporation
Sinclair Refining Company
Socony Vacuum Oil Company
Standard Oil Company of California
Standard Oil Company of Indiana
Standard Oil Company of New Jersey

The Ljungstrom is no stranger to refineries. For years it has been a standard item for utilizing waste heat from power and process steam boilers. These refiners now use Ljungstrom Air Preheaters on steam boilers . . .

Cit-Con Oil Corporation • Continental Oil Corporation
Esso Standard Oil Company • Humble Oil & Refining Company
Magnolia Petroleum Corporation • Pan-American Refining Company
Phillips Petroleum Company • Shell Oil Company
Standard Oil Company of Indiana
Standard Oil Company of Louisiana
Standard Oil Company of New Jersey • The Pure Oil Company
The Texas Company • Tidewater Associated Oil Company
Wilshire Oil Company

..... *with the* **Ljungstrom Air Preheater**



The Ljungstrom operates on the continuous regenerative counter-flow principle. The heat transfer surfaces in the rotor act as heat accumulators. As the rotor revolves, the heat is transferred from the waste gases to the incoming cold air.

In every refinery vessel that burns fuel, air preheat shows the way to save as much as *one barrel out of every five*. In view of the 200,000,000 barrels of fuel refineries burn every year, this means the *Ljungstrom Air Preheater* can recover tens of millions of *production dollars* that are now going up the stack.

The Ljungstrom removes precious BTU's from exit gases and transfers them to combustion air. Its effectiveness can be gauged from the fact that every 35-40°F of preheat means roughly a 1% saving in fuel costs – and Ljungstroms now in service preheat air to well over 600°F.

In addition to saving as much as 20% of your fuel, more effective fuel utilization means that your equipment can deliver greater throughput . . . can burn lower grade fuels with less slagging . . . lets you eliminate convection surfaces without reducing production.

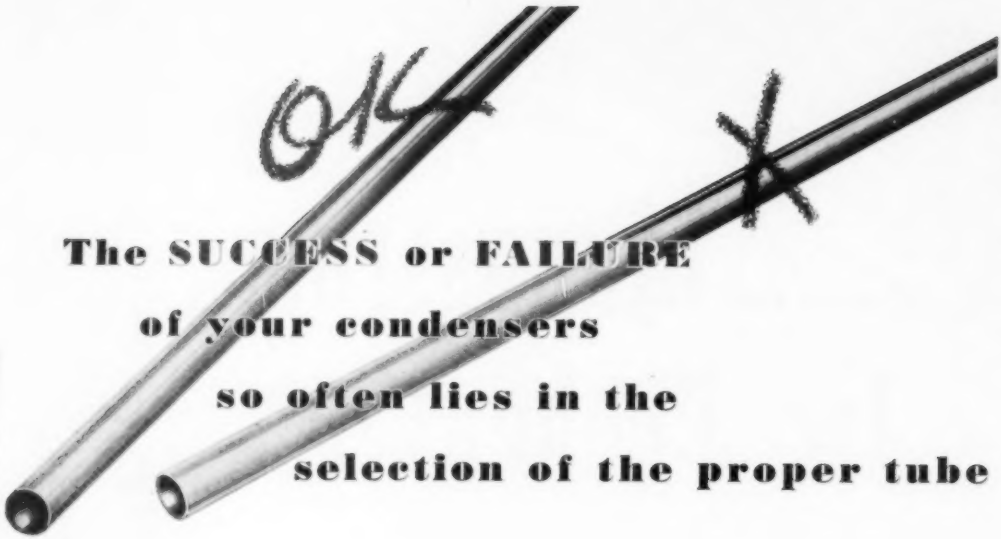
In these days of high fuel costs, every refinery should consider the Ljungstrom for new installations or modernization of existing equipment. Call or write The Air Preheater Corporation for full details.

Wherever You Burn Fuel, You Need Ljungstrom

Consider Ljungstrom Air Preheaters for . . .

Catalytic Cracking
Coking
Petrochemical Production
Petrochemical Separation
Petrochemical Synthesis
Polyforming
Propane Deasphalting
Reforming
Solvent Refining
Thermal Cracking
Visbreaking

THE AIR PREHEATER CORPORATION
60 East 42nd Street, New York 17, N. Y.



The SUCCESS or FAILURE of your condensers so often lies in the selection of the proper tube

After all, a tube — or actually a quantity of tubes — is charged with a large share of a condenser's function. Because so much depends upon the physical ability of the tube to "carry on", the selection of the tube—the right tube—is indeed of great importance.

When you select your tube, make sure it is of the proper copper base alloy to meet the conditions that prevail in your particular operations.

If you are not absolutely certain of the right alloy to use, or if you are interested in checking up on the latest developments in tubes for condenser operations — and to learn about some of our laboratory findings — we invite your correspondence.

WOLVERINE TUBE DIVISION
Calumet & Hecla Consolidated Copper Company
INCORPORATED
Manufacturers of seamless, nonferrous tubing
1431 Central Avenue • Detroit 9, Michigan

PLANTS IN DETROIT, MICHIGAN AND DECATUR, ALABAMA
Sales Offices in Principal Cities

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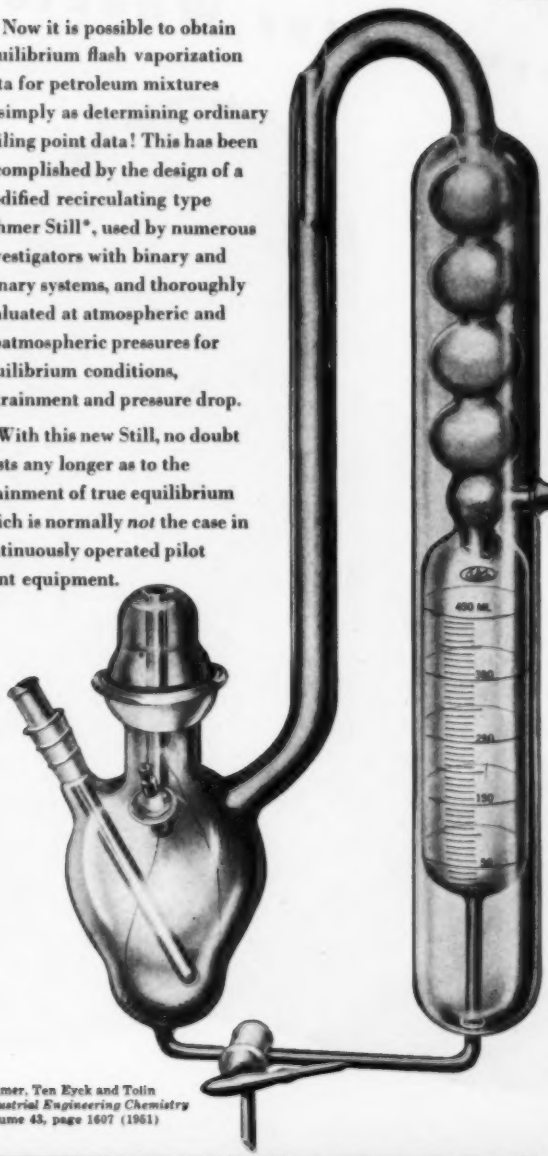
never before!

attainment of
true equilibrium
so SIMPLY!
so INEXPENSIVELY!
so ACCURATELY!

Flash Vaporization Equilibrium Still

■ Now it is possible to obtain equilibrium flash vaporization data for petroleum mixtures as simply as determining ordinary boiling point data! This has been accomplished by the design of a modified recirculating type Othmer Still*, used by numerous investigators with binary and ternary systems, and thoroughly evaluated at atmospheric and subatmospheric pressures for equilibrium conditions, entrainment and pressure drop.

■ With this new Still, no doubt exists any longer as to the attainment of true equilibrium which is normally *not* the case in continuously operated pilot plant equipment.



*Othmer, Ten Eyck and Tolin *Industrial Engineering Chemistry* Volume 43, page 1607 (1951)

why it is wise to use the flash vaporization equilibrium still

- *It is a compact unit which may be set up on a laboratory bench top.*
- *The initial cost is a fraction of that for the continuous type.*
- *Only a small quantity of charge material is required per determination—e.g., 500 to 2000 ml. per flash curve as compared with about 2 barrels for the continuous type.*
- *It requires a minimum of routine attention from one operator who may carry on other work concurrently.*
- *It allows the determination of the initial boiling point of the mixture and all points of vaporization up to about 92%.*
- *There is negligible pressure drop through the unit. This permits reading of the pressure at a point where condensing vapors do not clog the manometer.*

price list

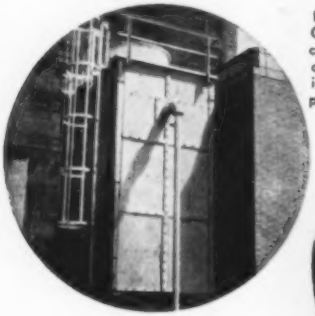
G7374—Equilibrium Still, Flash Vaporization, Othmer Type. Complete as illustrated with internal heating coil and connectors.
each $139.50

The EMIL GREINER Co.
20-26 N. MOORE STREET NEW YORK 13, N.Y.

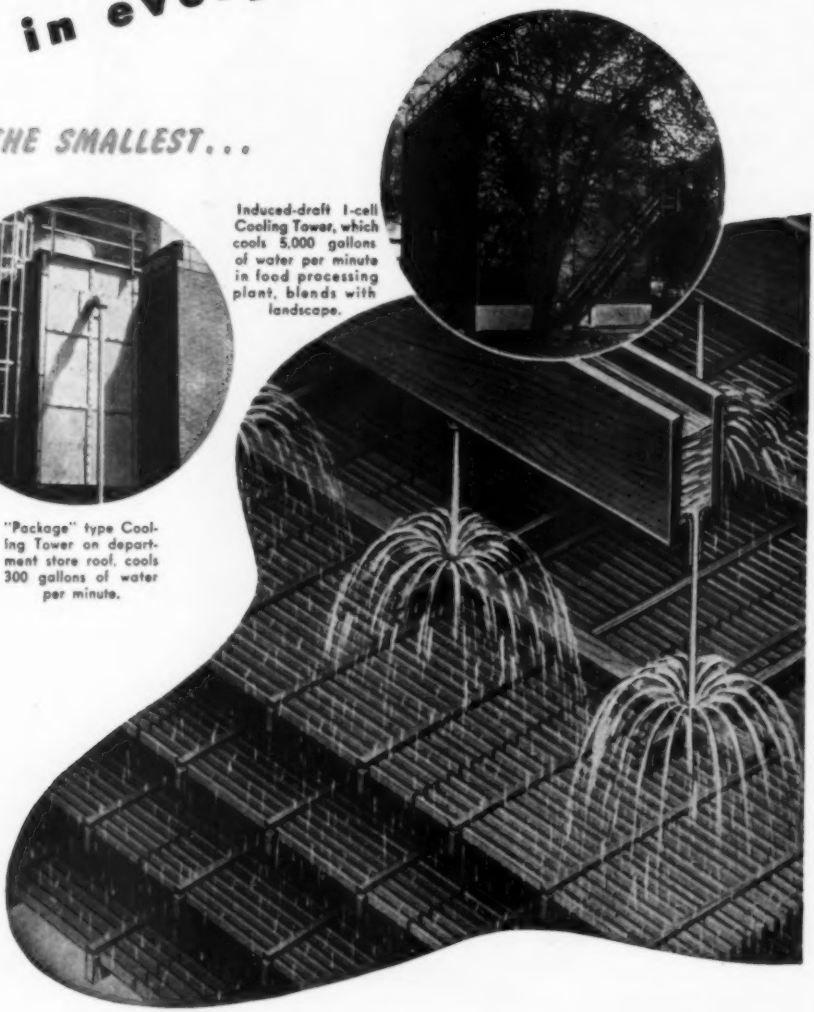
the same engineering excellence

in every Foster Wheeler

FROM THE SMALLEST...



"Package" type Cooling Tower on department store roof, cools 300 gallons of water per minute.

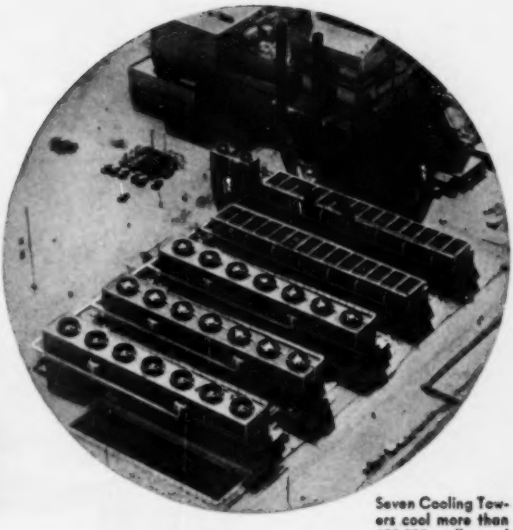


Induced-draft 1-cell Cooling Tower, which cools 5,000 gallons of water per minute in food processing plant, blends with landscape.

FOSTER WHEELER CORPORATION 165 BROADWAY

cooling tower

Induced draft Cooling Tower in oil refinery cools 15,000 gallons of water per minute to within five degrees of the design wet bulb.



Seven Cooling Towers cool more than 180,000 gallons of water per minute in large power plant.

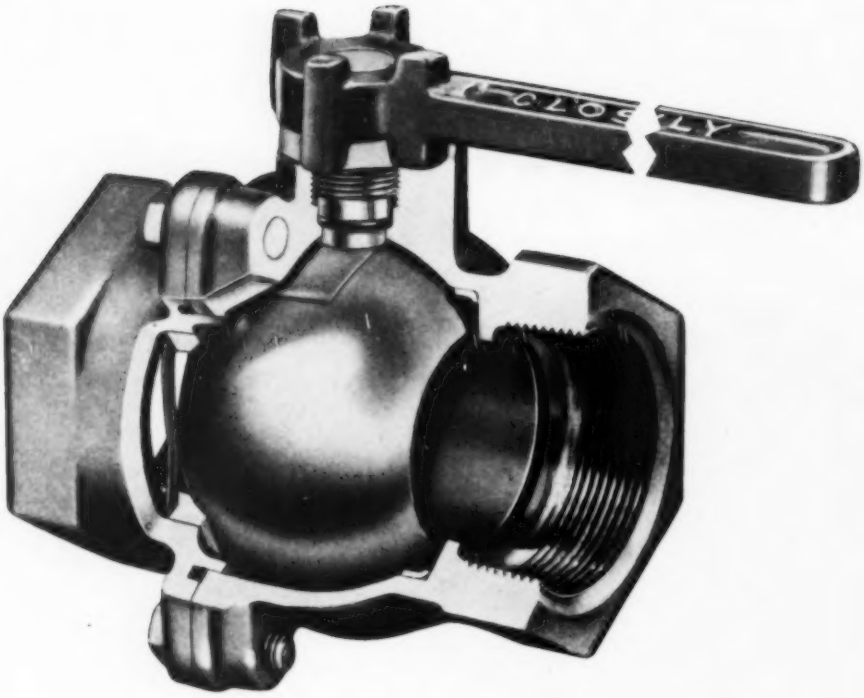
. . . TO THE LARGEST

Whatever the application—a "package" type on a department store roof in New York City, a twenty-cell tower for a power plant in Arkansas, or a large unit for a chemical plant in India, Foster Wheeler Cooling Towers can be depended on to deliver full capacity in year-round service.

A Foster Wheeler Cooling Tower is your best guarantee of a constant supply of cooling water for steam power plants, processing, air conditioning, or other uses. Regardless of size, the same engineering and construction excellence, the same attention to detail and the same quality of materials go into every Foster Wheeler installation.

NEW YORK 6, NEW YORK

FOSTER WHEELER



NEW BALL VALVE

gives you more of what you want in a valve

Full round flow... as full as if there were no valve in the pipe at all. Handles fluids with minimum friction loss . . . without turbulence.

Quick opening . . . Quick closing... even under full pressure. Needs only an easy quarter turn.

Resists wear longer . . . chrome-plated floating bronze ball is extremely resistant to scratching, pitting, abrasion.

Stays leakproof . . . When valve is in closed position, pressure of fluid automatically positions ball against synthetic rubber seat to form a tight seal.

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ROCKWOOD

ROCKWOOD BALL VALVES

ROCKWOOD SPRINKLER COMPANY

102 Harlow Street, Worcester 5, Mass.

A serious fire, yes, but no "total loss"—thanks to the protection of adjacent equipment by smothering blankets of water from a

BLAW-KNOX AUTOMATIC FOG SYSTEM

Actuated by rate-of-rise thermostats, this system sounds an alarm and instantly throws a dense, quenching fog of water on the danger spot—either extinguishing or controlling the blaze while protecting adjacent equipment.

A Blaw-Knox System engineered for the fire hazards existing in or around your plant is a most effective weapon against fire's toll. Your insurance savings as they accrue applied to its cost—provide you with the utmost in fire protection plus a good financial investment . . . Glad to consult with you and submit an estimate without obligation.

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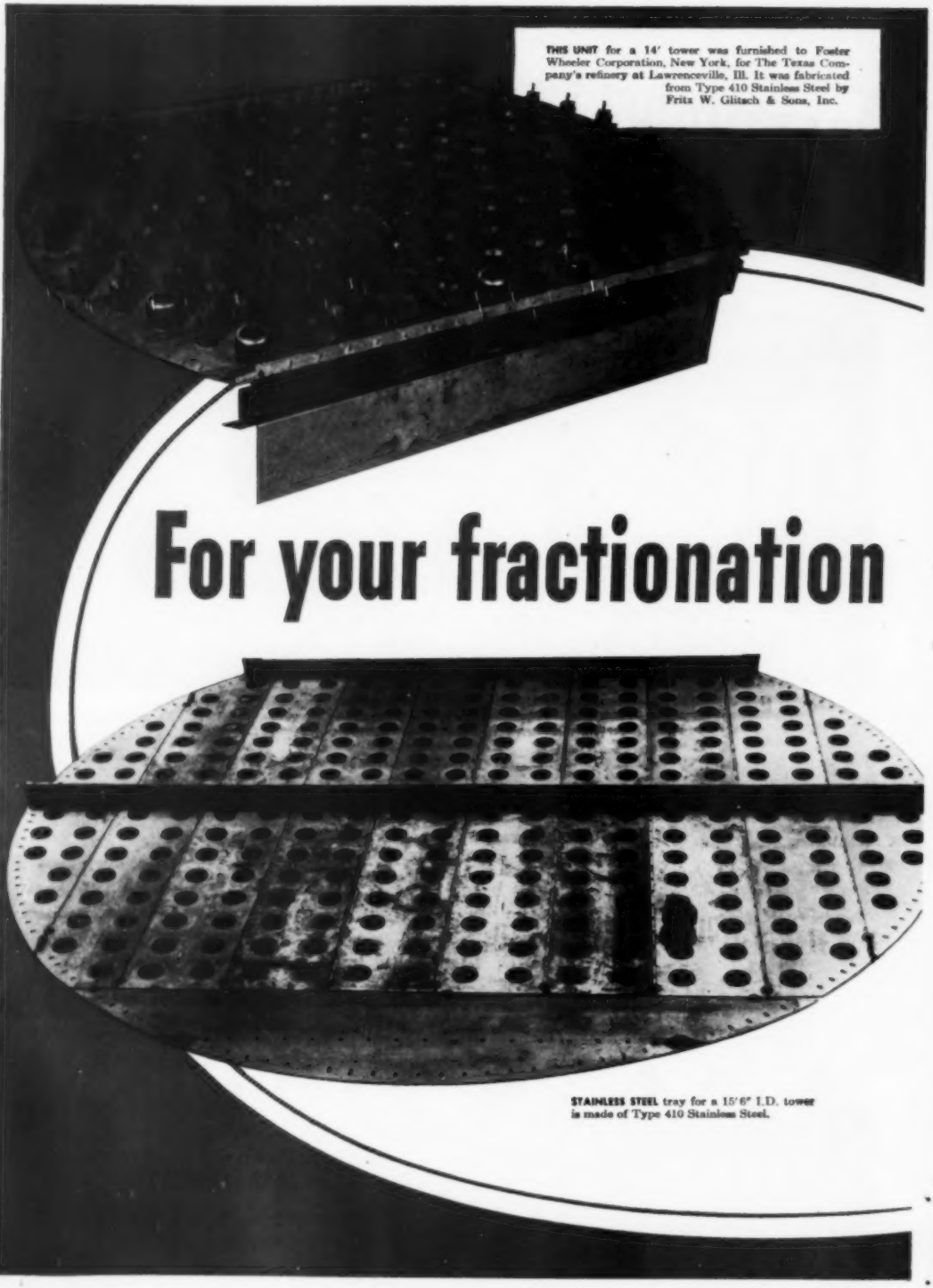
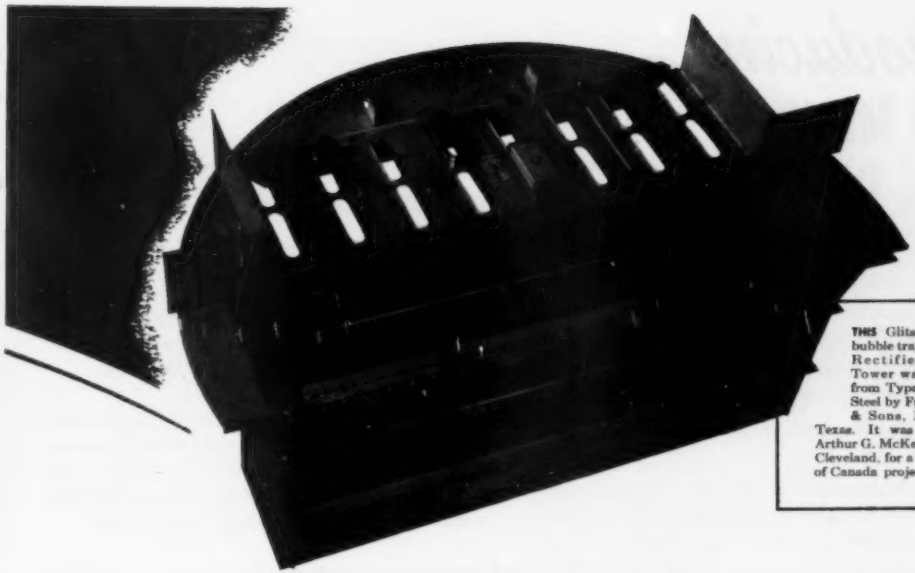
Deluge Systems, Wet Pipe Systems, Dry Pipe Systems, Water Spray and Fog Systems, Rate-of-Rise Sprinkler Systems, and Foam and Carbon Dioxide Extinguisher Systems.

"LITTLE JOEY SPRINKLER"
Always on the Job

BLAW-KNOX


THIS UNIT for a 14' tower was furnished to Foster Wheeler Corporation, New York, for The Texas Company's refinery at Lawrenceville, Ill. It was fabricated from Type 410 Stainless Steel by Fritz W. Glitsch & Sons, Inc.
For your fractionation
STAINLESS STEEL tray for a 15'6" I.D. tower is made of Type 410 Stainless Steel.



THIS Glitsch truss-type bubble tray for a 6'6" I.D. Rectified Absorber Tower was fabricated from Type 410 Stainless Steel by Fritz W. Glitsch & Sons, Inc., Dallas, Texas. It was furnished to Arthur G. McKee & Company, Cleveland, for a Shell Oil Co. of Canada project.

tower "internals" take advantage of available U·S·S 12 Stainless Steel

(no CMP tickets needed)

USED in bubble caps, trays, weirs, risers, floors, trusses, major beams, uptakes and downcomers, U·S·S 12 (Type 410) Stainless Steel offers maximum corrosion resistance for your money. At the same time, use of this available straight-chromium grade helps conserve the supply of nickel-bearing Stainless Steels.

Type 410 Stainless Steel has a long history of satisfactory service in these types of applications. As long as ten years ago, more than 500 sets of bubble caps and trays fabricated from Type 410 were in use and giving highly satisfactory service.

One fabricator who has used Type 410 Stainless extensively since 1938 finds it has a life 6 to 7 times that of carbon steel under normal operating conditions.

This grade of Stainless Steel has excellent resistance to the corrosive conditions encountered in fractionation towers. And it resists the effect of temperatures encountered in this type of operation—as high as 1000°F.

Stainless Steel's dense, smooth surface prevents coking and fouling, thus permitting longer runs with less down time for cleaning. Its strength and toughness mean less breakage and less wasted tray area. Because of its high corrosion resistance and its formability, thinner sections can be used and one-piece bubble caps, risers, etc. can be made. Together, this makes possible longer life and lighter weight units.

U·S·S 12 Stainless Steel—a service-tested material—will give you unmatched performance in these internal parts. Specify it to your fabricator; he needs no CMP tickets for any form of this material.

UNITED STATES STEEL COMPANY, PITTSBURGH · AMERICAN STEEL & WIRE DIVISION, CLEVELAND · COLUMBIA-GENEVA STEEL DIVISION, SAN FRANCISCO
NATIONAL TUBE DIVISION, PITTSBURGH · TENNESSEE COAL & IRON DIVISION, FAIRFIELD, ALA. · UNITED STATES STEEL SUPPLY DIVISION, WAREHOUSE DISTRIBUTORS
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U·S·S STAINLESS STEEL

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SHEETS · STRIP · PLATES · BARS · BILLETS · PIPE · TUBES · WIRE · SPECIAL SECTIONS

2-385

UNITED STATES STEEL

Introducing A NEW MEMBER OF THE INCO FAMILY INCOLOY

Incoloy is a wrought nickel-chromium-iron alloy, developed as a nickel-saving companion to Inconel. It is a high-temperature material with good resistance to oxidation, strength at elevated temperatures and workability comparable to that of Inconel.

The principal engineering characteristics of Incoloy are:

- **Oxidation Resistance** – the oxidation resistance of Incoloy is of the same order as Inconel. It has a chromium content of 21%.

INCOLOY
Mechanical Property Ranges of Standard Forms at Room Temperature

Form & Condition	Tensile Properties: Tensile Strength 1000 psi.	Yield Strength (0.2% Offset) 1000 psi.	Elongation in 2 in. per cent	Hardness: Brinell 3000 kg.	Rockwell
Rod and Bar					
Cold-drawn					
Annealed	75-100	30-55	50-30	120-170	66-86B
As-drawn	100-150	80-125	30-10	180-290	90B-30C
Hot-Rolled					
Annealed	75-100	30-55	50-30	120-170	66-86B
As-rolled	80-120	35-90	50-25	135-220	74-96B
Forged	80-120	35-90	50-25	135-220	74-96B
Wire					
Cold-drawn					
Annealed	75-105	25-55	50-25	.....	.....
Plate					
Hot-rolled					
Annealed	75-105	30-55	50-30	120-180	.....
As-rolled	80-120	35-90	50-25	135-220	.....
Sheet					
Cold-rolled					
Annealed	75-100	30-55	50-30	.....	88B (max.)
Deep drawing and spinning quality	75-100	30-45	55-35	.....	80B (max.)
Strip					
Cold-rolled					
Annealed	75-100	30-50	50-30	.....	84B (max.)
Deep drawing and spinning quality	75-100	30-45	55-35	.....	80B (max.)
Tubing					
Cold-drawn					
Annealed	75-100	30-55	50-30	.....	88B (max.)

- **Expansion Co-efficient**—The expansion co-efficient is approximately that of Inconel. Thus Incoloy should have about the same high-temperature resistance to cracking under drastic temperature change.

- **Structure**—Because of its relatively high nickel content (32%) the structure of Incoloy is stably austenitic showing no tendency to become embrittled by precipitation of sigma or carbidic phases after prolonged exposure to intermediate temperatures.

- **Room Temperature Properties**—Room temperature mechanical property ranges of Incoloy mill forms are shown in the table on the left.

- **High Temperature Applications** – In terms of behavior in various high-temperature environments, it is anticipated that Incoloy will be superior to Inconel in resistance to sulfidation, green-rot and molten cyanide salts and comparable to Inconel in resistance to oxidation and in fused neutral salts.

- **Fabrication**—Incoloy is workable, both hot and cold. It is machinable, though high-speed steel tools should be used.

- **Work Hardening** – The rates of work hardening of Incoloy and Inconel are practically identical.

- **Welding**—For metal arc welding, "132" Inconel electrode is recommended for all gauges. For inert gas metal arc, "62" Inconel filler wire is recommended. Sheet or strip up to ¼" may be joined by this method.

Forms supplied – Incoloy is produced in the usual mill forms – billets, rounds, flats, hexagons, sheet and strip, tubing and wire, but like all Inco Nickel Alloys, it is on extended delivery because of defense demands.

THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street, New York 5, N. Y.

NICKEL (INCO) ALLOYS

MONEL® • "R"® MONEL • "K"® MONEL • "KR"® MONEL
"S"® MONEL • NICKEL • LOW CARBON NICKEL • DURANICKEL®
INCONEL® • INCONEL "X"® • INCOLOY® • NIMONICS

WHY Nalcat® FLUID CRACKING CATALYSTS ARE YOUR BEST BUY

1 DEPENDABLE QUALITY

Production of Nalcat Cracking Catalysts is rigidly controlled to assure uniform high quality in every pound of material delivered to users.

2 MEETS SPECIFICATIONS

Whether you use standard Nalcat grades, or require catalyst to your specifications, Nalcat is guaranteed to meet specifications fully.

3 PROMPT DELIVERY

Delivery, as promised, can be an important factor in catalyst purchases. When you buy Nalcat, you can be certain of delivery on the dot.

Nalcat FLUID CRACKING CATALYSTS

CATALYST DIVISION, NATIONAL ALUMINATE CORPORATION
4001 West 71st Street • Chicago 29, Illinois

PIPING THAT MOVES

. . . calls for supports that are flexible

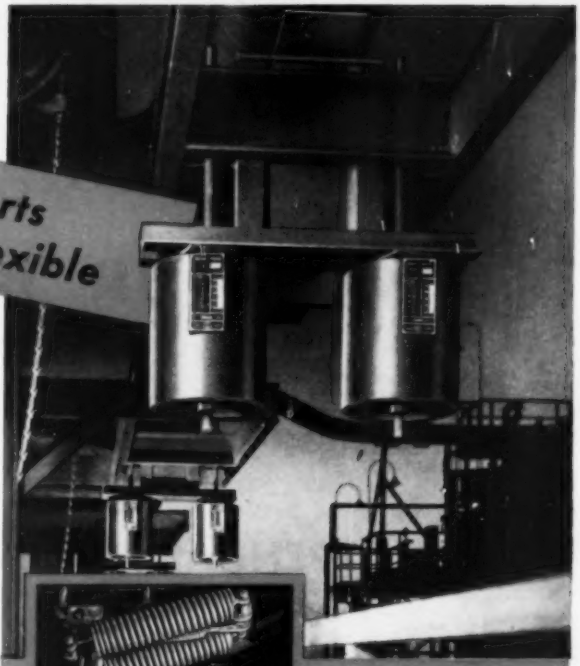
Thermal deflection of piping in the high temperature piping systems of today's oil refineries requires supports that are flexible.

Where reactive forces at terminal points in a piping system must be kept within specified limits, constant-support type hangers are recommended. They are designed to provide substantially uniform supporting force equal to the pipe load throughout the travel range and should be used on high temperature and other critical lines.

When pipe lines are subject to vertical movement and restrictive conditions do not require the use of a constant-support type, variable spring hangers are recommended. They should be designed to support not less than 85% or more than 120% of the designed load for the total travel.

When necessary to prevent abnormal movement or vibration in pipe lines, controls or sway braces of the energy-absorbing or instant-acting, counter force type are recommended.

Grinnell manufactures a complete line of engineered pipe hangers and supports; maintains a laboratory staff of trained technicians; provides highly skilled assistance and advice right from the design stage; and offers experienced field engineering service.



Grinnell Pre-Engineered Variable Spring Hangers installed in one of the largest catalytic cracking plants.

Grinnell Constant Support on piping operated at temperatures up to 1100°F.

GRINNELL MODEL L CONSTANT SUPPORTS—maintain full safety factor in high temperature, high pressure systems. 2 physical structures accommodate maximum travel requirements of 2½ 5 and 10 inches; 16 sizes collectively cover numerous load ranges between 141 and 19,530 pounds.

GRINNELL PRE-ENGINEERED SPRING HANGERS—maximum variation in supporting force per ½" of deflection is 10½% of rated capacity—in all sizes. 16 sizes available from stock—load range from 74 lbs. to 9000 lbs.

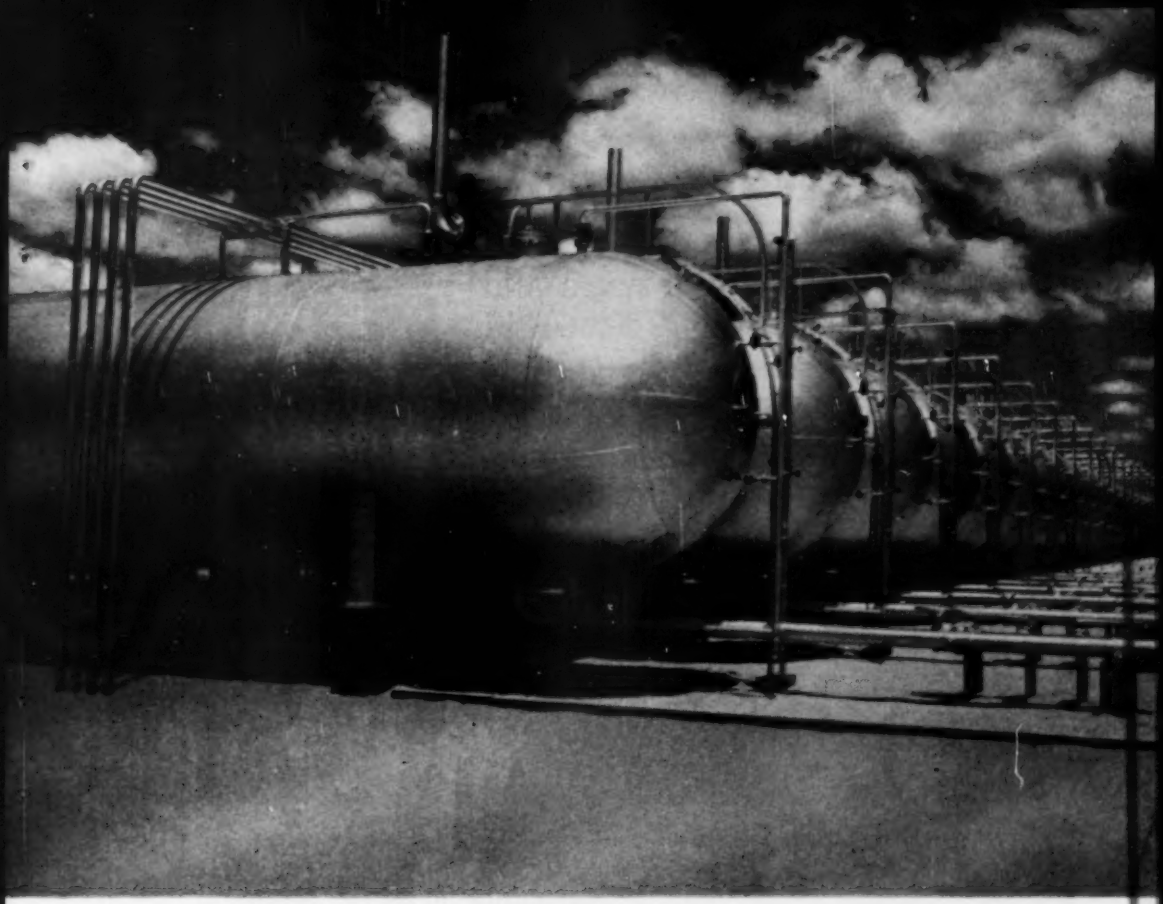
GRINNELL VIBRATION CONTROL AND SWAY-BRACES—dampen vibration, oppose pipe sway and absorb shock. 3 sizes give full deflection forces from 200 to 1800 lbs.; have initial precompressed spring forces from 30 to 450 lbs. respectively.

GRINNELL

AMERICA'S #1 SUPPLIER OF PIPE HANGERS AND SUPPORTS

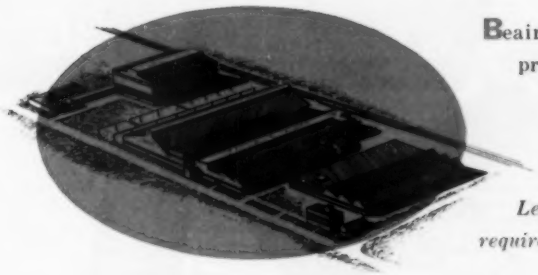
Grinnell Company, Inc., Providence 1, Rhode Island • Coast-to-Coast Network of Branch Warehouses and Distributors

pipe and tube fittings • welding fittings • engineered pipe hangers and supports • Thermolier unit heaters • valves
Grinnell-Saunders diaphragm valves • pipe • prefabricated piping • plumbing and heating specialties • water works supplies
industrial supplies • Grinnell automatic sprinkler fire protection systems • Amco air conditioning systems



A bank of 24 Beaird pressure storage tanks in a North Louisiana gasoline plant.

BEAIRD PRESSURE STORAGE TANKS



Beaird has specialized in the fabrication of pressure storage tanks for over three decades. Today, hundreds of Beaird tanks are installed in gasoline plants and chemical plants throughout the country.

Let us quote you on your pressure storage requirements.

THE J. B. BEAIRD COMPANY, INC. **SHREVEPORT, LOUISIANA**

PACKAGED COMPRESSOR PLANTS

L.P.G. SYSTEMS

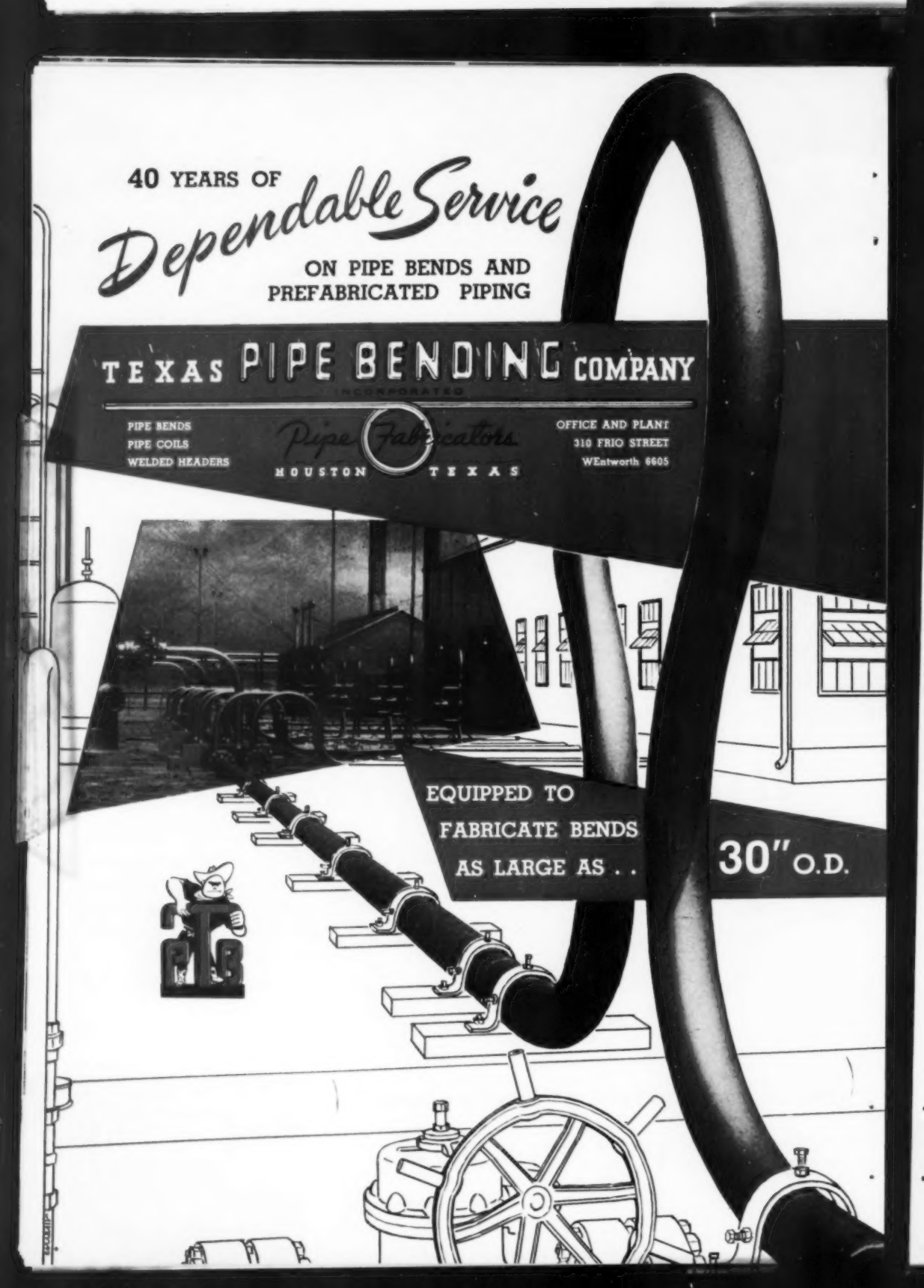
CAST STEEL FITTINGS

ANHYDROUS AMMONIA EQUIPMENT

MACHINING
FABRICATING
STEEL WAREHOUSE

SINCE 1918
BEAIRD
SHREVEPORT

...RED FOR SAFE ...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Dependable Service
ON PIPE BENDS AND
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EQUIPPED TO
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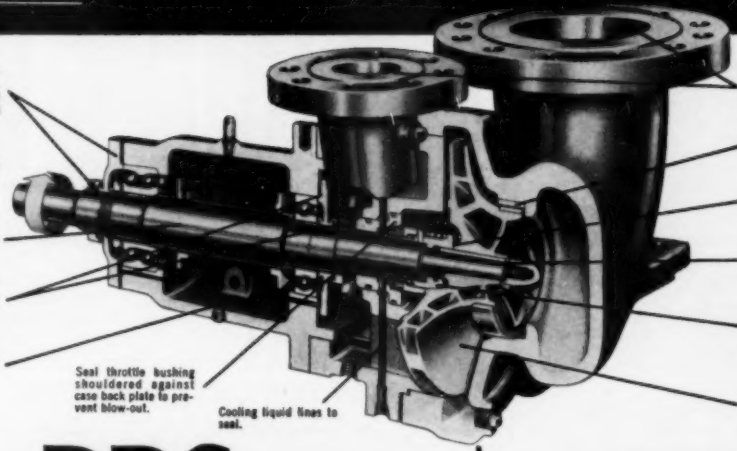
30" O.D.

First FROM PEERLESS

A HEAVY DUTY REFINERY & CHEMICAL PROCESS PUMP DESIGNED *WITH AND FOR* A MECHANICAL SHAFT SEAL


Slinger and special recessed bearing cap provide an effective seal without wearing parts.
Heavy duty thrust and radial bearings oil-lubricated.
Precision alloy steel, heat-treated, shaft.
Slinger and special recessed bearing cap provide an effective seal without wearing parts.
Extra large capacity oil reservoir.
Seal throttle bushing shouldered against case back plate to prevent blow-out.
Cooling liquid lines to seal.
Top suction and top discharge design. End-suction design available.
Case and impeller wearing rings are spot electric welded.
Mechanical shaft seal assembly.
Lock washer secures hex nut on shaft.
Seal sleeve keyed to shaft, gasketed at shaft shoulder to prevent leakage under sleeve.
Enclosed type impeller is keyed to shaft; re-pelling vanes on back shroud.

PEERLESS type PRS PROCESS PUMP

The Peerless Type PRS pump is designed *specifically* for mechanical shaft seal construction. All the advantages of proved mechanical seals are inherent in the Type PRS pump design.

1. LONGER LIFE. Mechanical seal design permits use of short shaft. A shorter shaft means greater rigidity, less deflection, minimum run-out, less wear in bearings, wear rings, seal and moving parts.

2. GREATER SAFETY. Throttle bushing is shouldered against case back plate from suction side; cannot blow out even under maximum operating pressure.

3. MORE ECONOMICAL. No premium is charged in first cost for the mechanical shaft seal construction of the Type PRS pump. Lower maintenance costs will be effected throughout its longer life.

4. AVAILABLE IN SEVERAL SIZES. Peerless Type PRS pumps are available for quick assembly and shipment from Peerless' Los Angeles stock in several sizes.

5. ENGINEERING CONSULTATION SERVICE. Help on selection and application of the Type PRS pumps to your problems is available from the Peerless factory or the Peerless field engineer or distributor nearest you.

PEERLESS PUMPS

Characteristics AT A GLANCE

Capacities	up to 1000 gpm
Operating Heads	up to 625 feet
Case Pressures	up to 400 psig
Temperatures	up to 250° F
Drives	horizontal electric motor is standard; other types available as required.

APPLICATIONS

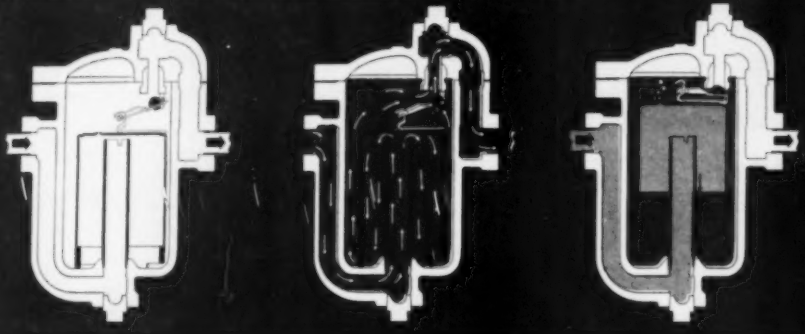
Use the Peerless Type PRS pump for handling all petroleum hydrocarbons, process liquids, water, hot oil, LP-gases. Liquid end can be furnished in material suitable to the intended service.

PEERLESS BUILDS *Dependable* PUMPS

Write or wire today for further engineering information.

PEERLESS PUMP DIVISION
FOOD MACHINERY AND CHEMICAL CORPORATION
Address inquiries to Factories at:
Los Angeles 31, California and Indianapolis 8, Indiana
Offices: New York, Chicago, St. Louis, Atlanta; Dallas, Plainview and Lubbock, Texas; Fresno, Los Angeles; Phoenix, Albuquerque, N. M.; Tulsa

ARMSTRONG TRAPS are



A WORKING PICTURE OF ARMSTRONG DESIGN

1. When trap is first installed, the inverted bucket is down and the valve is wide open.

2. When steam is turned on, condensate (solid color) flows into trap and out through discharge orifice, until . . .

3. steam (light color) reaching the trap floats the inverted bucket and closes the valve.

THE highly efficient design of modern Armstrong traps directly reflects over 40 years' experience in inverted bucket trap manufacture and application gained since Armstrong developed the first practical inverted bucket trap in 1911.

Armstrong design offers:

- A "frictionless" leverage system which combines high leverage with wide opening of a large orifice.
- A minimum of parts.
- Strong, corrosion-resistant and wear-resistant materials.
- Generous margins of safety.

For trap users this means:

- Large capacity.
- Dependable service under adverse operating conditions.
- Low maintenance.
- Continuous operation of heating and process equipment.

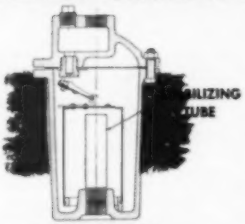
The soundness and benefits of Armstrong design have been proved in thousands and thousands of plants all over the world. To insure dependable condensate drainage for a new plant or plant expansion, simply specify: "Traps shall be Armstrong." For additional information, call your local Armstrong Representative or write:

ARMSTRONG MACHINE WORKS
852 Maple St., Three Rivers, Michigan

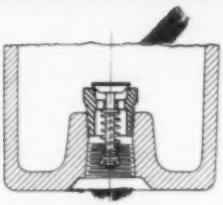
SELF-SCRUBBING ACTION (see Fig. 2 above). Note that condensate first flows down between bottom of bucket and trap body, then up and out through orifice. The high velocity flow under bottom of bucket keeps dirt in suspension, washes it out when trap opens. No dirt problems with Armstrong design.

BUCKET FLOATS WHEN LESS THAN ⅔ FULL OF STEAM (see Fig. 3 above). The generous margin of safety (dimension A in Fig. 3 above) insures that the bucket will float with trap body partly full of water. A heavier bucket would give more power but it might not float and close the valve.

SOME OTHER ARMSTRONG



STABILIZING TUBE
Condensate, air and steam are admitted above water level in trap bucket. The water level is undisturbed, eliminating wear-producing agitation of the bucket, valve lever and valve. This exclusive feature greatly lengthens life of working parts.

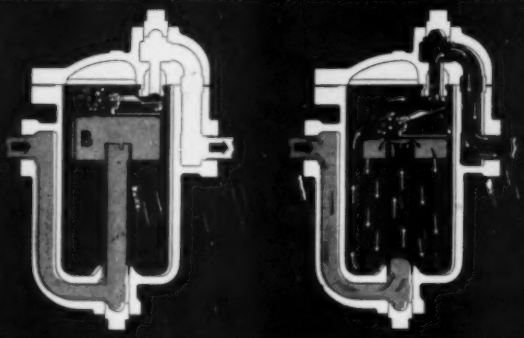


INTERNAL CHECK VALVE
All Armstrong traps can be equipped with the Armstrong spring-loaded stainless steel check valve. Costing less than an external check valve, it also saves installation labor and fittings.

ARMSTRONG · INVERTED BUCKET STEAM TRAP

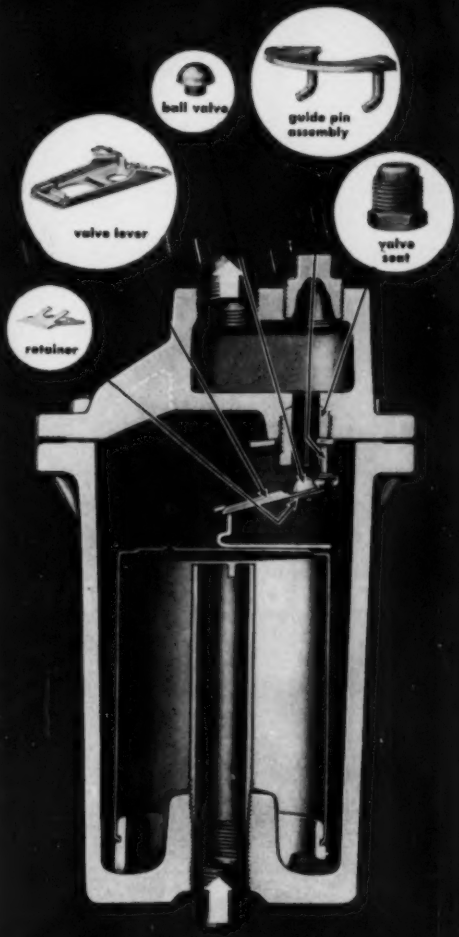
ARMSTRONG

Designed to give be



4. When more condensate enters the trap, the bucket loses buoyancy and pulls on valve lever.

5. When weight of bucket times leverage overcomes pressure on valve, bucket sinks and opens trap.

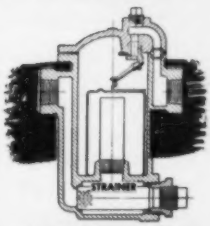


NO AIR BINDING (see Fig. 4 above). Air mixed with steam passes through the bucket vent, collects at top of trap and is discharged ahead of condensate. The large air-handling capacity of Armstrong traps insures top equipment temperatures and faster heat-up.

EXCESS POWER PROVIDED FOR OPENING TRAP (see Fig. 5 above). Weight of bucket times leverage opens trap. Here again Armstrong design provides a generous safety margin. Reducing dimension B in Fig. 4 would increase power of bucket but margin between test opening pressure and operating pressure would be too low to allow for normal wear and for pressure fluctuations.

TRAP DESIGN FEATURES

THERMIC VENT BUCKET
Where large amounts of air must be discharged when steam is turned on, and where air can be pushed out ahead of incoming steam, this bucket will speed heat-up greatly. The vent is open when trap is cold, closes at 210° F. Has 50 to 100 times air handling capacity of standard buckets.

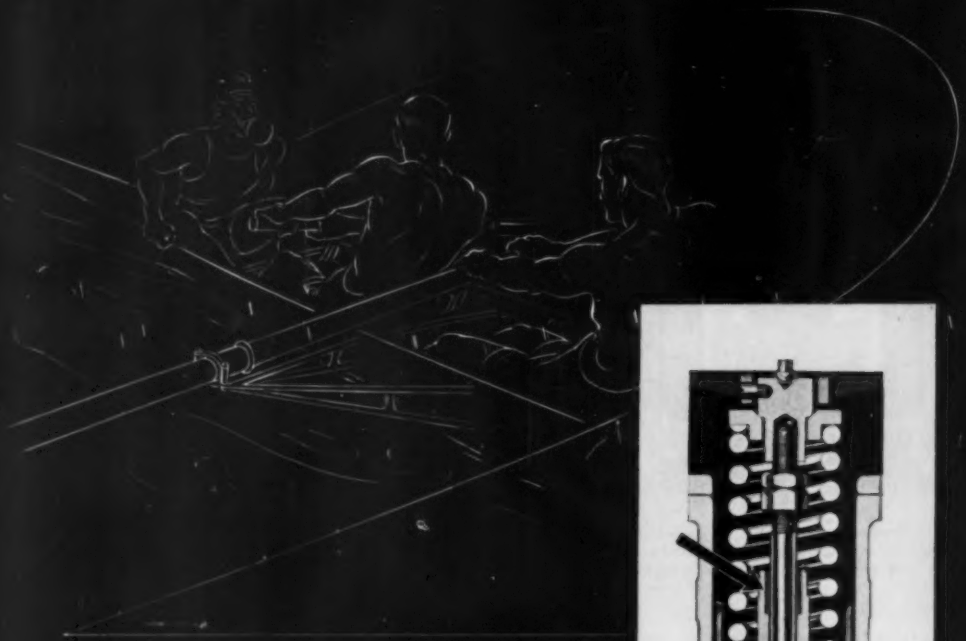


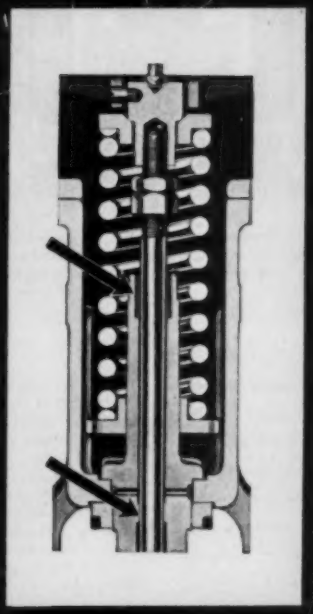
INTEGRAL STRAINER TRAPS
The two smallest sizes of Armstrong traps, most apt to need strainer protection, are available in a body style having the strainer built right in. The strainer can be cleaned while trap is operating.

SEND FOR *NEW*
44-PAGE STEAM TRAP BOOK

Complete data on Armstrong trap design and operation; physical data and list prices; capacities; selection, installation and maintenance recommendations. Free on request.

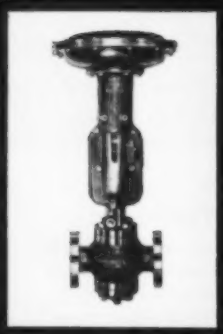
STEAM TRAPS





GUIDED STROKE...

for smoother stem movement



The two-point guiding of the upper stem in the Honeywell Series 700 Valve eliminates side thrust by supporting the stem at top and bottom in continuously lubricated bearings . . . assuring practically frictionless response to the slightest changes in signal air pressure. The Honeywell Series 700 wide band proportional valve comes in a full range of styles and sizes . . . has *all* the features you look for in a fine valve. Write today for your copy of Bulletin 700-2.

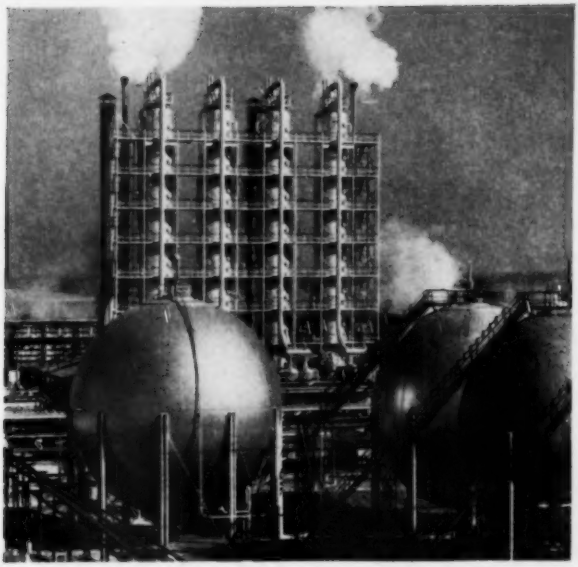
MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, 1907 Windrim Avenue, Philadelphia 44, Pa.

MINNEAPOLIS

Honeywell

VALVE PRODUCTS

First in Controls



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Strong, tough, long-lasting ENDURO stubbornly resists rust and corrosion. It resists the action of most acids and alkalies. Its hard, smooth surface discourages coking and fouling—is easy to wash down quickly during "off-stream" periods.

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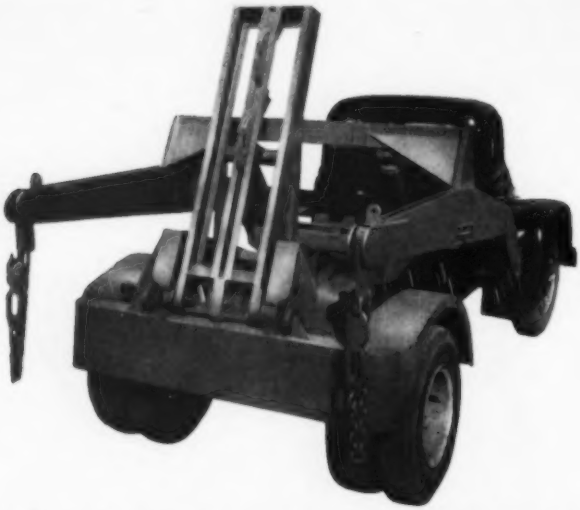

WHY USE 3 TO 5 TRUCKS... WHEN ONLY ONE WILL DO?

In many plants a Dempster-Dumpster, like the one above, operated by only one man, the driver, has replaced 3 to 5 conventional trucks and crews. The reason for this is that one truck-mounted Dempster-Dumpster serves scores of Dempster-Dumpster Detachable Containers up to four times the capacity of the average dump truck body. These containers are built in a wide variety of designs best suited to the type of materials handled—be they bulky, light or heavy . . . solids or liquids . . . trash or rubbish. Containers are conveniently located at accumulation points inside and outside buildings. To illustrate the flexibility of the Dempster-Dumpster System in handling all types of materials in your plant, we show, at right, a few of the dozens of Dempster-Dumpster Containers built to meet every bulk materials handling need. And remember, one truck-mounted Dempster-Dumpster handles all containers, regardless of capacity or design.

The Dempster-Dumpster System eliminates standing idle time of crews and trucks . . . eliminates re-handling of materials . . . increases efficiency, sanitation and good housekeeping . . . cuts cost of truck equipment and operation tremendously. Without question, it's the most efficient and lowest cost method of bulk materials handling by truck ever devised! The chances are this system will save you thousands of dollars annually. This equipment manufactured and sold exclusively by Dempster Brothers, Inc.

WHEN A CONTAINER IS FULL, the Dempster-Dumpster picks it up, hauls to destination and dumps the materials or sets load down intact. These three simple operations, shown above, are hydraulically controlled by driver in truck cab.

Drop Bottom Container built up to 10 cu. yd. capacity to handle heavy materials.

Tank Type Container meeting A.S.M.E. specifications. Capacities up to 1,200 gallons.

Tilt Type with Converged Lip for handling fine aggregate, wet or fluid materials.

Drop Bottom Pressed Steel Type for lighter service.

Universal Type built up to 12 cu. yd. capacity with top and end doors.

Five cu. yd. container with swivel casters for handling waste blast sand.

DEMPSTER BROTHERS, 562 Dempster Bldg., Knoxville 17, Tennessee

Coasting is fine for him—but not for us

A good friend of ours asked us not so long ago, "Why does Ethyl keep up all this activity—research, advertising, educational shows, exhibits, customer services of all kinds? Why not just make your product and sell it?"

The answer is very simple. The U. S. petroleum industry is a progressive, up-hill business and a very competitive one.

That industry buys "Ethyl" antiknock compound from us and adds it to their gasoline. Furthermore, they change and improve their gasoline from year to year. To be prepared for those changes—and to be sure that refiners get the most from every cc of "Ethyl" antiknock compound, we must be continually exploring ahead.

(*Continued on next page*)

Coasting is fine for him—but not for us

(*Continued from preceding page*)

At the same time, engines, lubricating oils and operating conditions are changing—so we try to be ready with the answers to the various technical problems that arise.

And since gasoline containing "Ethyl" fluid must ultimately be sold to consumers, we aim to keep out in front with up-to-the-minute merchandising and advertising help for our customers in all parts of the country.

We regard ourselves as part of the petroleum business, and that makes us part of your business. The petroleum industry has never coasted. It has always pushed on to greater and greater accomplishments. And you can be sure that Ethyl people will always be ready and anxious to do their share of the pushing.

ETHYL CORPORATION
NEW YORK 17, NEW YORK

Ethyl service is backed by 29 years of antiknock experience

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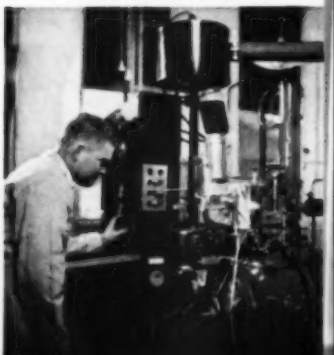
SUPPLY SERVICE

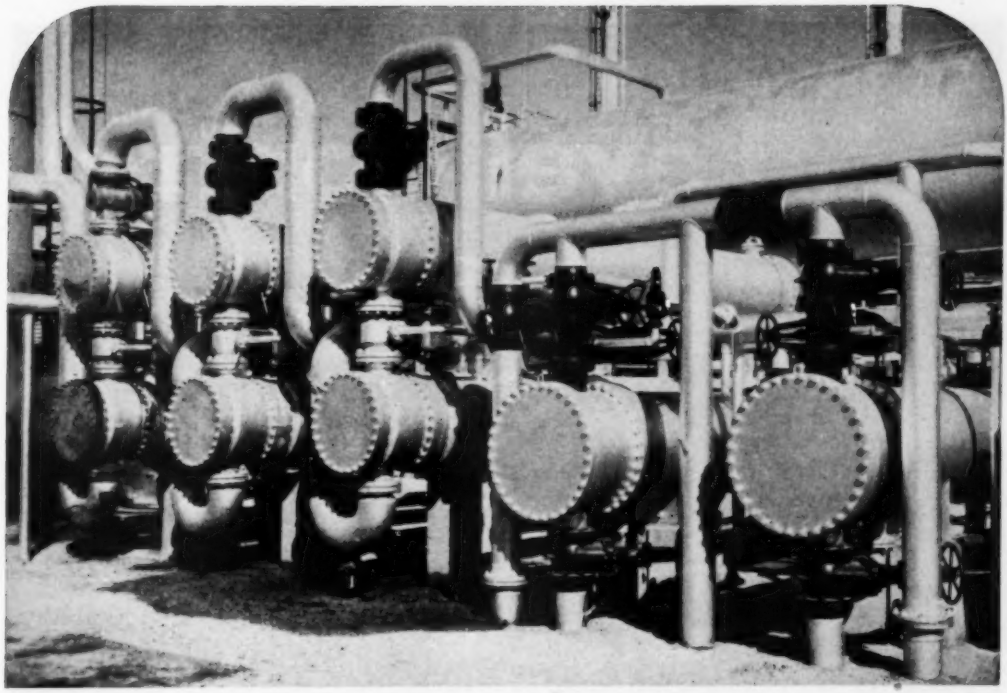
TECHNICAL NOTES

SALES HELPS

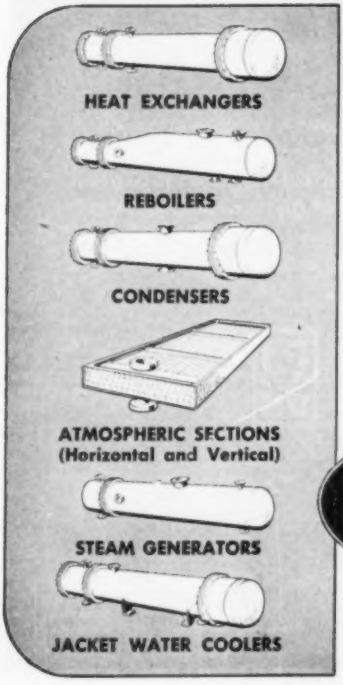
ROAD TESTING

GASOLINE TESTING





Make sure your Heat Exchangers are



"EFCO Engineered"

● Heat exchangers by EFCO specialists are carefully designed to meet *your* specific requirements. EFCO heat exchangers give you long, trouble-free operation plus the extra advantages of lasting tightness, optimum heat exchange, and minimum maintenance costs.

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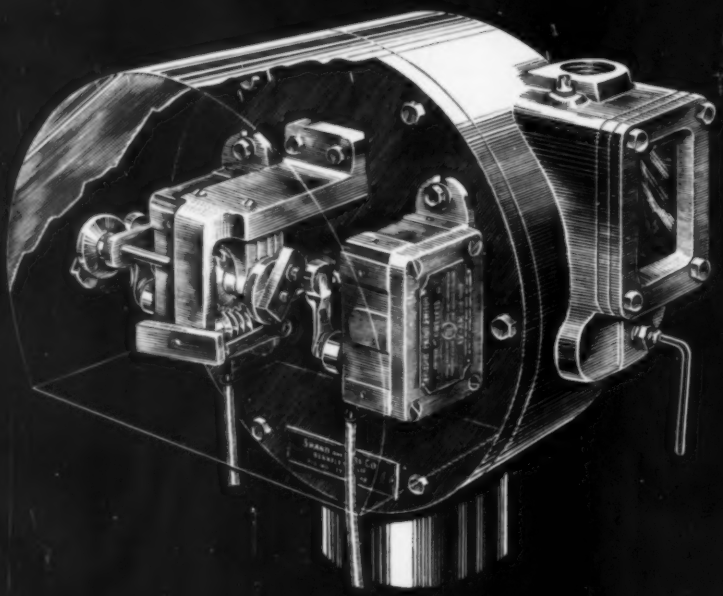
EFCO

HEAT TRANSFER EQUIPMENT

Economical Level Control



THIS Shand & Jurs High Low level control or level alarm is designed for direct mounting on any automatic, low pressure S&J petroleum tank guage. Its design eliminates drilling, piping and disturbance of tank contents, and with underground tanks, the necessity of excavation, for installation.

Designated Fig. ST-7448, the S&J level control or alarm can sound horns, ground magnetos, control lights or alert operating personnel by other means to correct any undesired condition before a danger point is reached.

The S&J High Low level control or alarm employs explosion proof Micro Switches actuated by the shaft of the gauge tape drum through means of gears and cams. Available with 1, 2, 3 or 4 Micro Switches, the S&J level control or alarm is adjustable to very close limits.

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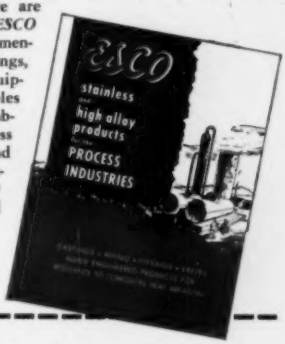

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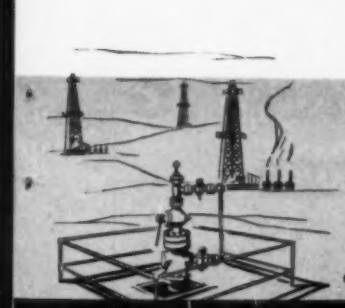
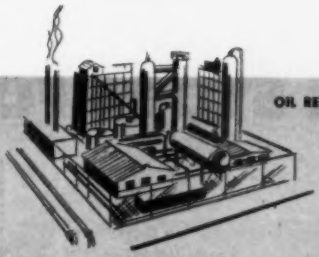
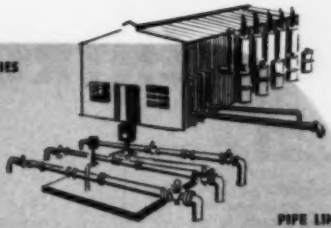


OIL FIELD



OIL REFINERIES



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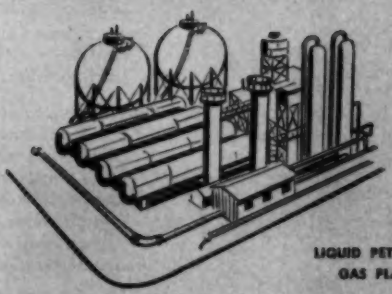
LIFT-PLUG VALVES

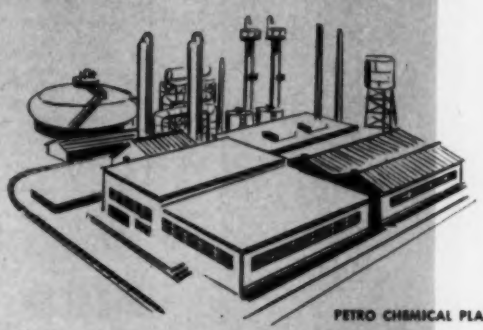
1. THEY REQUIRE NO LUBRICATION MAINTENANCE: Unlike ordinary valves which require lubricant to effect a seal and/or to counteract frictional forces for ease of operation, the Cameron Valve needs no lubrication. Result: No lubrication maintenance, no chance for human error, no grease to buy, no danger of contaminating the line product or of fouling meter orifices.

2. THEY OPEN AND CLOSE WITH THE GREATEST OF EASE: The lift, turn, re-seat principle employed by the Cameron Valve has long had recognized advantages. By means of a novel plug actuator, the plug is lifted free of the seat, turned 90 degrees to open or closed position, and then re-seated. On direct-operated models, less than ¾-continuous turn of a lever is required to operate the valve.

3. THEY SEAL TIGHTLY: The seat is a separate member, not attached to the valve body; consequently, line strains or body distortion cannot disturb the geometry of the fit between the plug and seat. Actually, line pressure causes the separate seat to grip the plug tightly, thus aiding rather than hindering the seal.



LIQUID PETROLEUM GAS PLANTS



PETRO CHEMICAL PLANTS

Cameron

IRON WORKS, INC.

P. O. BOX 1212 • HOUSTON, TEXAS

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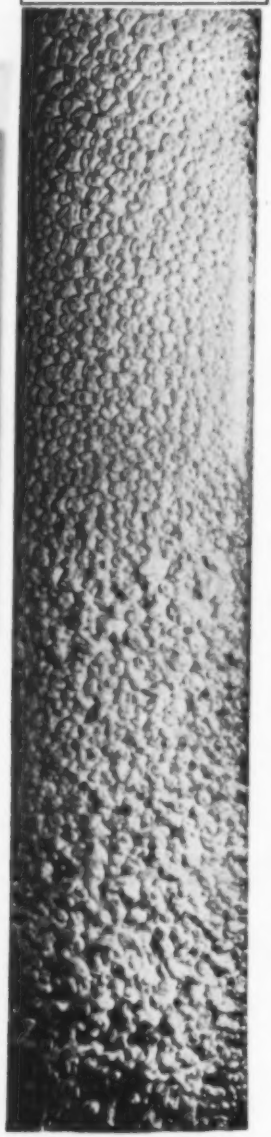
CONCENTROL STOPS FOAMING

BEFORE

Laboratory demonstration shows foaming of highly alkaline solution in test cylinder.



This laboratory demonstration shows — as do scores of successful installations — that Bird-Archer's Concentrol is a highly effective anti-foam agent. It quickly stabilizes alkaline boiler water . . . eliminates foaming action and carryover. With Concentrol, you can forget about bouncing water gages. You get good quality dry steam every hour of every day.

Concentrol is available in liquid, powdered or briquette forms. Special Concentrol formulations are also available containing other commonly used boiler water treatment chemicals such as tannins, phosphates, alkalies, sulfite, etc.

See for yourself how economical Concentrol helps improve steam quality. Your Bird-Archer representative will demonstrate Concentrol in your plant . . . make specific recommendations for its use. Consult him, or write direct to Bird-Archer, outlining the details of your boiler operation.

FREE DATA SHEET AVAILABLE

HOW CONCENTROL WORKS

Concentrol works by effecting a rapid change in surface tension of steam bubbles which permit coalescence of small steam bubbles into bubbles of larger sizes. This results in the formation of unstable bubble films which break readily upon reaching the steam disengaging surface of the boiler water. This does away with foam build-up and subsequent carryover.

BIRD · ARCHER

WATER TREATMENT

THE BIRD-ARCHER COMPANY

4337 North American St., Philadelphia 40, Pa.

NEW YORK · CHICAGO

IN CANADA

The Bird-Archer Co., Limited

Cobourg, Ontario

IN MEXICO

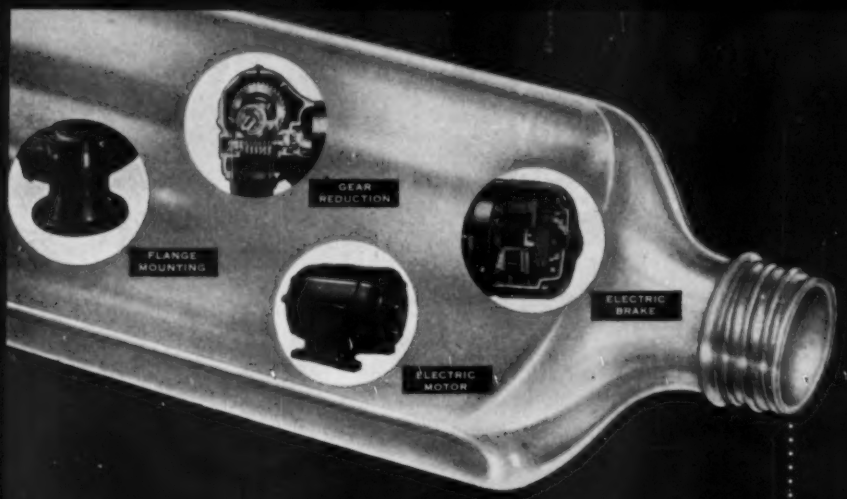
Calderas y Accesorios, S. A.

Amsterdam 291, Mexico D. F.

BA 162

AFTER

Same solution after addition of 12 ppm of Concentrol Anti-foam. Constant heat conditions were maintained during test.



There's no one cure-all

Each case is different. But you can select from Masters broad line the correct combination of features to give you the RIGHT horsepower, the RIGHT shaft speed, the RIGHT construction features, the RIGHT mounting . . . all combined into one compact power package.

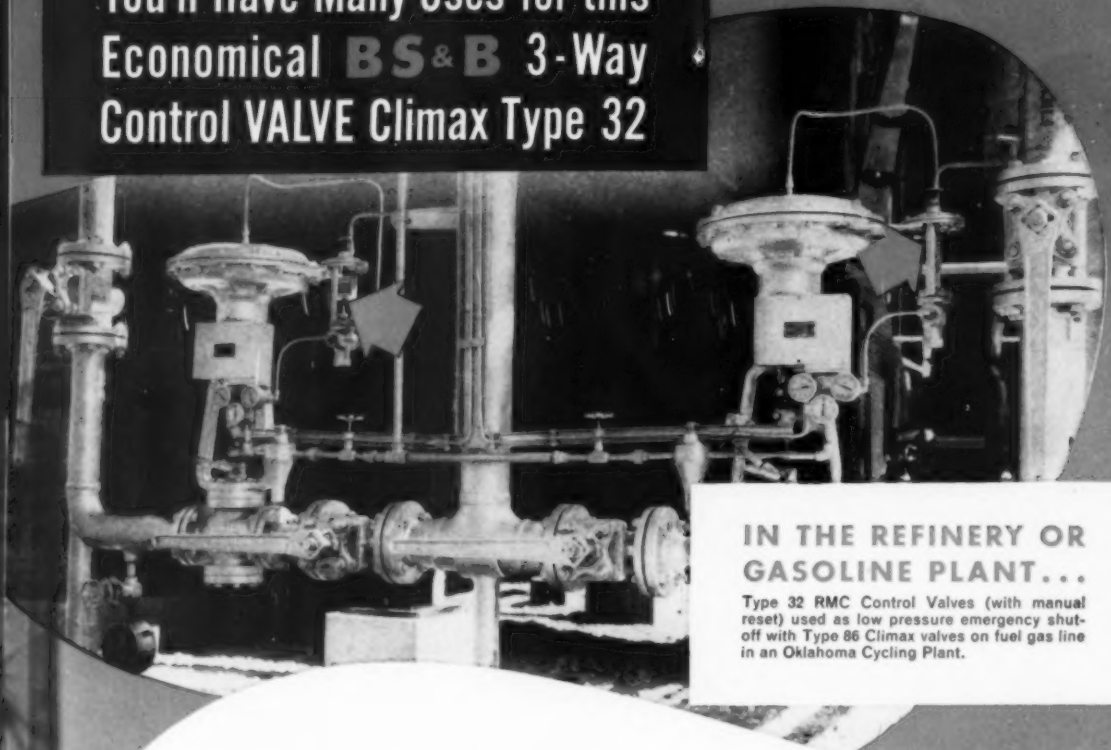
Master Motors, available in thousands and thousands of types and ratings (⅛ to 200 HP) give you a breadth of selection you can get nowhere else. Master engineers can be completely impartial in helping you select the one best drive for you.

Use Master Motors to increase the salability of your motor-driven products . . . improve the economy and productivity of your plant equipment. They're the horsesense way to use horsepower.

THE MASTER ELECTRIC COMPANY
DAYTON 1, OHIO

ELECTRIC MOTORS

You'll Have Many Uses for this Economical BS&B 3-Way Control VALVE Climax Type 32



IN THE REFINERY OR GASOLINE PLANT...

Type 32 RMC Control Valves (with manual reset) used as low pressure emergency shut-off with Type 86 Climax valves on fuel gas line in an Oklahoma Cycling Plant.

Designed for service with low differential pressure across the valve, having a small diaphragm area, Climax Type 32 Control Valve is both economical and versatile. As a three-way valve the spring holds the upper or horizontal ports closed when control medium is not applied to the diaphragm; as pressure is applied, the upper port opens for straight-through flow and the lower port closes.

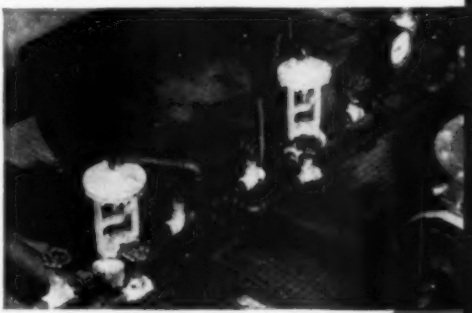
To convert Type 32 to an inexpensive control or direct regulator it is only necessary to plug one of the valve outlets. Thus, with one horizontal outlet plugged (Type 32-D) with the bottom outlet plugged (Type 32-R). With these easy modifications you have, within their capacities, very efficient control valves, reducing regulators or back pressure valves. The Type 32 with hookup variations will serve many unique applications in safety shutdown systems or alarm signals.

The cast iron body, stainless steel inner valve and Neoprene diaphragm make Type 32 a rugged *and* versatile adjunct to your controls system.

WRITE FOR Complete Literature on Type 32 and other Climax Diaphragm Control Valves. Ask for Catalog Section 105. Your nearest BS&B branch office has an expert on Climax Controls to assist you with your problems.

IN THE FIELD...

Climax Type 32-R valves used as automatic pressure controls to shut down pumps supplying low-pressure separator on Gulf tidelands platform at over-pressure or pressure drop.



CLIMAX BS&B CONTROLS

BLACK, SIVALLS & BRYSON, INC.

Climax Controls Division, Dept. 4-F6

7500 E. 12th St. • Kansas City 3, Mo.

Get

something extra

when you buy

lead pipe and fittings

Quantity, size, type, physical composition . . . these are what you specify when buying lead pipe and fittings.

Do one thing more, however. Specify National and get certain extras...extras that take full advantage of lead's ability to withstand attack by corrosives.

For one example, when you specify National "Tubond" pipe and fittings, you get the corrosion resistance of lead combined with the strength of steel, in a virtually inseparable union of lining and casing. You get equipment designed to handle acids under difficult conditions of temperature, pressure and vacuum. You get full flow-way. You get greater security against leakage, because of extra lead on flange faces.

Extras in design, in fabrication, in careful chemical composition. To get them make this specification: National!

Lead pipe and fittings with a NATIONAL reputation

LEAD COMPANY

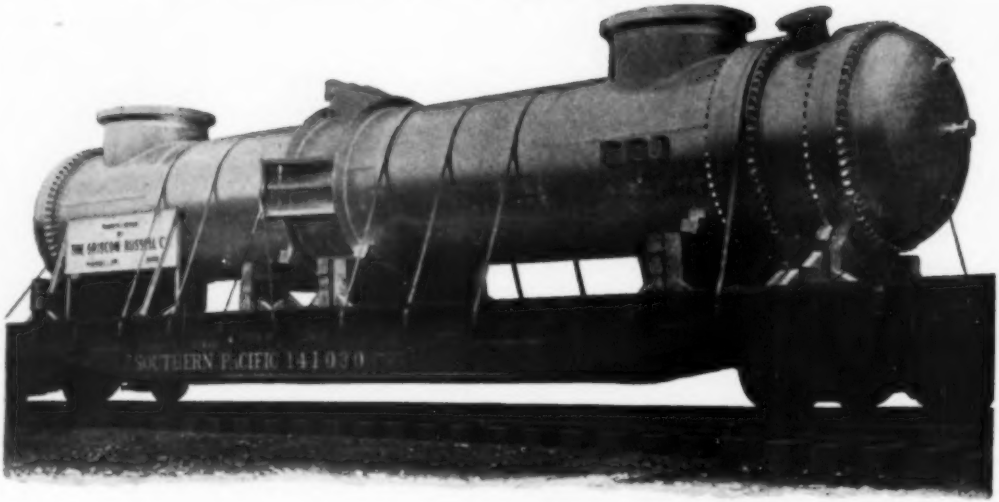
New York 6; Atlanta; Baltimore 3; Buffalo 3; Chicago 8; Cincinnati 3; Cleveland 13; Dallas 2; Philadelphia 25; Pittsburgh 12; St. Louis 1; Boston 6 (National Lead Co. of Mass.); Los Angeles 23 (Morris P. Kirk & Son, Inc.); Toronto, Canada (Canada Metal Company, Limited)

*Reg. U. S. Pat. Off.

No Limit!

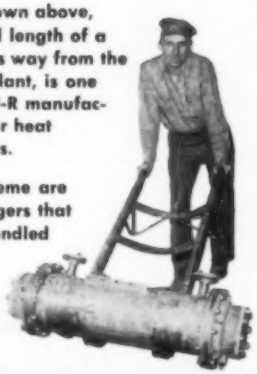
to type of

G-R Tubular Heat Exchangers



The huge unit shown above, occupying the full length of a 53-ft flat car on its way from the Griscom-Russell plant, is one example of the G-R manufacturing facilities for heat transfer apparatus.

At the other extreme are G-R Heat Exchangers that can be readily handled by one man.



Between the two extremes of the illustrated G-R Tubular Exchangers are the many types of G-R Heaters, Coolers, Condensers, Evaporators and Heat Exchangers, of which Griscom-Russell has built almost 200,000 to handle all types of liquids, gases and vapors for all industries.

Each G-R design is based on the 85-year specialized experience of the oldest and largest exclusive manufacturer of heat transfer apparatus. Each type has many distinctive features that assure superior effectiveness, economy and durability.

Write for 32-page bulletin describing G-R Tubular Heat Exchangers in detail.

THE GRISCOM-RUSSELL COMPANY
MASSILLON, OHIO

GR 570

GRISCOM-RUSSELL
PIONEERS IN HEAT TRANSFER APPARATUS

If Your Research and Development Program Involves Sulfonations... get these

4 TIMELY AIDS ON

Sulfan*

STABILIZED SULFURIC ANHYDRIDE

GENERAL CHEMICAL SULFAN is stabilized liquid sulfur trioxide. It provides Industry with sulfuric anhydride in a convenient "workable" form, ideally suited to many processes involving sulfonations and sulfations.

WITH THE DEVELOPMENT OF SULFAN, many long-recognized, but hitherto impractical uses of sulfuric anhydride have been made possible. In production of detergents, dyestuffs, pharmaceuticals, textile wetting agents, organics, plastics, and other products, SULFAN has given evidence of offering important economies and advantages. Possibly it can do the same for you.

FOR RESEARCH AND DEVELOPMENT GROUPS interested in studying this important new chemical tool, experimental quantities of SULFAN are available. In addition, General Chemical has prepared four technical bulletins on SULFAN. Each one is packed with useful information. You will find them extremely helpful if your work involves sulfonations, or indicates their use. When writing for your copies, please fill in coupon completely, or make inquiry on your business letterhead.

CONTENTS OF SULFAN TECHNICAL SERVICE BULLETINS

Bulletin SF-1—SULFAN
Gives potential uses, physical properties.

Bulletin SF-2—"Reactions of SO_3"
Lists reactions with aliphatic organic compounds, reactions with aromatic organic compounds, reactions with inorganic materials.

Bulletin SF-3—"Storage, Handling and Use of SULFAN"
Safety and precautions, laboratory evaluations, sulfonation techniques, bulk handling, vaporization of SULFAN.

Bulletin SF-4R—"Use of SULFAN in manufacture of Alkaryl Sulfonate Detergents".
Contains latest information on the SULFAN method.

BASIC CHEMICALS
GC
FOR AMERICAN INDUSTRY

*SULFAN is General Chemical's registered trade-mark for liquid sulfur trioxide.

GENERAL CHEMICAL DIVISION, Allied Chemical & Dye Corporation
40 Rector Street, New York 6, N. Y.

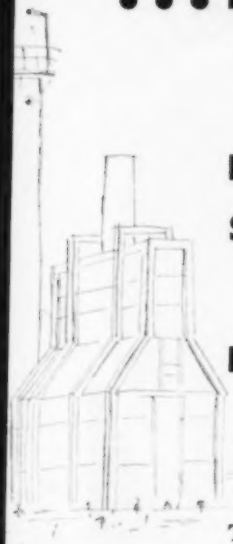
Please send me the following Technical Bulletins on SULFAN. (Check those that interest you).

☐ Bulletin SF-1 "Sulfan" ☐ Bulletin SF-2 Reactions of SO_3 ☐ Bulletin SF-3 Uses & Handling ☐ Bulletin SF-4R Use in Detergent Mfg.

Name_____
Organization_____
Title_____
Address_____
City_____ Zone_____ State_____ 1-6

FROM FILE TO FIELD

. . . IN ONE STEP



IMMEDIATE ERECTION OF STANDARD A, B, and C * PLATFORMING UNITS

NO DELAYS . . . NO WAITING FOR DESIGN DRAWINGS

This is big news for the refiner who needs Platforming . . . and in a hurry!

Procon can erect Platforming units of * 600, 1000, and 1500 barrel per day design capacities from drawings already on file. This means no time out for detail design—no extended interval between contract and construction.

Actual capacities of these Standard units will vary according to refiner's feed stocks and method of operation, but the range of sizes permits the refiner to choose the capacity best suited to his individual requirement.

This file-to-field service is the answer to fast, economical construction and enables the refiner to take the shortest route to profitable on-stream production with the widely accepted Platforming process.

PROCON

PROCON *Incorporated*

PROCESS CONSTRUCTION

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Simplest Flow Measurement

with the ALL-METAL Foxboro d/p Cell!

. . . gives fastest response, longest sustained accuracy, lowest installation cost

Simpler in design, simpler and much less expensive to install, far easier to maintain . . . the all-metal Foxboro mercury-less *d/p Cell* offers greater speed of response, permitting closer flow *control*, than has ever been possible before. Its negligible displacement and corrosion-proof construction of Type 316 Stainless Steel eliminate usual maintenance problems, even in service on highly corrosive or viscous fluids previously considered unmeasurable.

The Foxboro d/p Cell measures differential pressure by the force-balance principal and transmits pneumatically to indicating, recording, or controlling receivers. Small, compact, weighs as little as 19 lb. Ranges: from 25" to 800" H.O. Working pressure ratings up to 4000 psi. Steel or stainless steel construction. Inherent over-range protection. Easy in-the-field calibration and range changes. Optionally available with pre-assembled manifold piping shown in photo above.

Thousands of d/p Cells now in use throughout industry, with many repeat orders now on our books, indicate the wide acceptance and successful performance of this revolutionary development for the measurement of liquid, steam, gas, or air flow. Write for detailed Bulletin 420. **The Foxboro Company, 746 Neponset Avenue, Foxboro, Massachusetts, U. S. A.**

- No seal pots
- No mercury
- No leveling
- Installed at the orifice

FOXBORO
REG. U. S. PAT. OFF.

RECORDING · CONTROLLING · INDICATING
INSTRUMENTS

FACTORIES IN THE UNITED STATES, CANADA, AND ENGLAND

TERRY

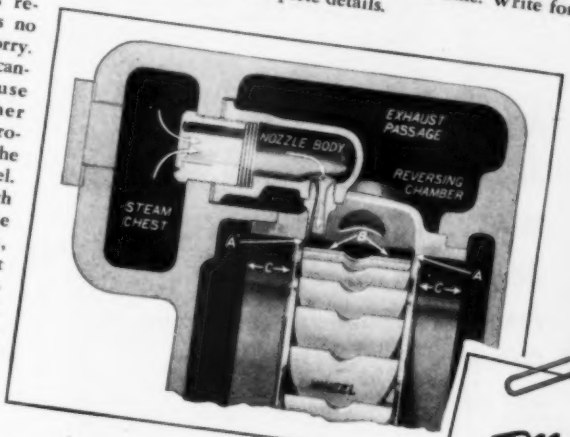
LARGE CLEARANCES *take the "worry" out of* Turbine Operation

In a Terry Solid-wheel Turbine the power-producing action of the steam in the wheel takes place on the curved surfaces at the back of the buckets. This unique design permits unusually large blade clearance—see B in the diagram.

Even if this clearance becomes reduced, there is no real cause for worry. The blades still cannot foul because they are further protected by projecting rims at the sides of the wheel. These rims, which also have ample clearances (AA), will take without damage any rubbing that may occur.

Side clearance, CC, is so large that end-play from external thrust will not damage the wheel. This clearance is one inch or even greater.

Large side and blade clearances are only two of the many features of the Terry Solid-wheel Turbine. Write for complete details.



THE TERRY STEAM TURBINE CO.
TERRY SQUARE, HARTFORD 1, CONN.

TT-1191

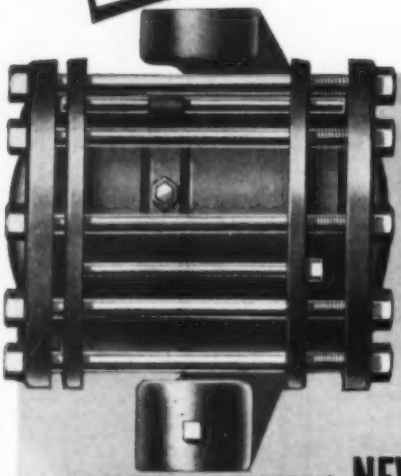
Memo

Send for a copy of bulletin S-116 which describes the many advantages of the Terry Solid-wheel Turbine.

Another AMERICAN® Advance

THE NEW

A MERCURYLESS METAL SUPPLEMENTING



AMERICAN METER'S NEW DIFFERENTIAL PRESSURE MEASUREMENT INSTRUMENT—

Adaptable to all American Pneumatic Controllers, Transmitters, Differential Valves, Telemeters and related instruments.

For differential pressure applications where accurate measurement is required without the use of a mercury manometer, American Meter Company now offers a bellows actuated instrument designed and built with characteristic American precision in ranges of 50", 100" and 200" for working pressures to 1,000 P.S.I. These new instruments are designed for ease of installation, accurate performance and minimum maintenance under rugged operating conditions.

• • •

Range changes are made easily and simply by removal of the low-side cover for access to the range spring without disturbing the high-side cover or any connections. Calibration, virtually tamperproof since all adjustments are internal, is readily performed by applying the differential pressure on the high-side with low-side cover removed. Damage or distortion to the bellows due to sudden over-range is prevented by stick-proof check valves with flat, synthetic seats. An additional bellows compensates for volume changes in bellows filling fluid resulting from ambient temperature variations. The Teflon-sealed pulsation dampener, for accurate control of instrument response, is externally adjustable under pressure.

• • •

American is and will continue to be the first name in metering dependability. For complete information on this latest addition to the American line . . . built with the precision and extreme care characteristic of American Meter Company's century-old tradition of "Sustained Accuracy at Lower Cost" . . .

Write for Specifications or Call the Nearest Office Listed Below

NO PRECISE LEVELLING — NO SEAL POTS REQUIRED
Pedestal, Panel or Overhead Hanger Mounting
— Top and Bottom Gage Line Connections

FOR WORKING PRESSURES TO 1,000 P.S.I.
... AMBIENT TEMPERATURES OF
—25° TO 175°F.

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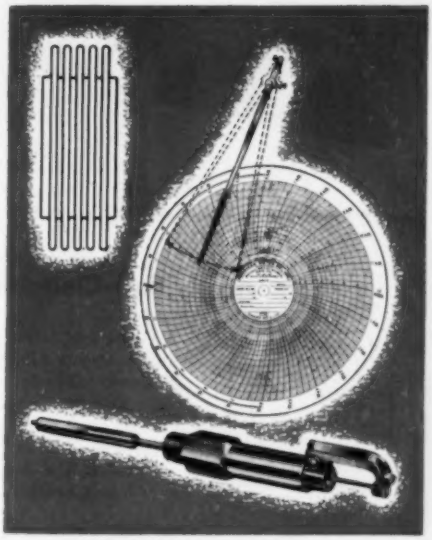
DRI-FLO ORIFICE METER

BELLOWS DIFFERENTIAL PRESSURE INSTRUMENT

THE AMERICAN WESTCOTT MERCURY MANOMETER ORIFICE METERS



- **ONE-PIECE STAINLESS STEEL BELLOWS CONSTRUCTION**

  Large area, fluid filled, *seamless* stainless steel bellows provide longer service life with minimum possibility of leaks caused by metal fatigue.

- **DIRECT FULL SCALE RECORDING PEN MOVEMENT— NO EXTERNAL GEARING OR LINKAGE MULTIPLICATION**

  Recording pen arm travels through the full 22½ degree arc without complex external gearing or linkage multiplication. Standard American Westcott charts are used.

- **AMERICAN TYPE "B" TEFLON SEAL STUFFING BOX NEEDS NO LUBRICATION**

  Noted for simplicity, this nearly frictionless precision unit provides maximum accuracy . . . *Requires No Lubrication.* All stuffing box parts are removable and replaceable in the field . . . *No Shaft Freezing; No Leakage.*

- **STAINLESS STEEL INTERNAL WORKING PARTS**

  All internal operating parts of the new DRI-FLO Orifice Meter are of stainless steel except the ground and polished stuffing box shaft which is Monel metal. Body is cast steel.

- **READILY ACCESSIBLE FOR CLEANING**

  The meter body and internal working parts are easily accessible for inspection, calibration and cleaning by removing one or both case cover heads . . . without disturbing manifold piping.

AMERICAN METER COMPANY
INCORPORATED ESTABLISHED 1836

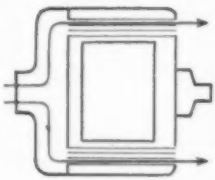
AMERICAN METER COMPANY EST. 1836 MEASUREMENT ENGINEERS

Your *Best* Motor Buy

for Explosion Danger Areas

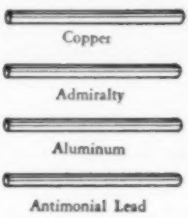
Here's Why

Practically Self-Cleaning



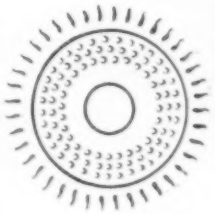
Air-to-air heat exchanger has straight, smooth tubes with no pockets to collect dirt or moisture. Velocity of cooling air through tubes keeps surfaces swept clean. If sticky dirt piles up, tubes can be cleaned quickly with long handled brush.

Choice of Tube Materials



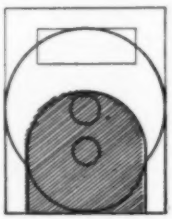
Allis-Chalmers tube-type motors can be built for service in corrosive atmospheres. Tubes may be made of a variety of materials. Motors will carry Underwriters' Label for Class I Group D or Class II Group F or Class II Group G.

Uniform Cooling



Tubes for carrying cooling air are distributed uniformly around the perimeter of the stator and along its full length. Result: heat travels over a short path and the interior is uniformly cooled.

Compact

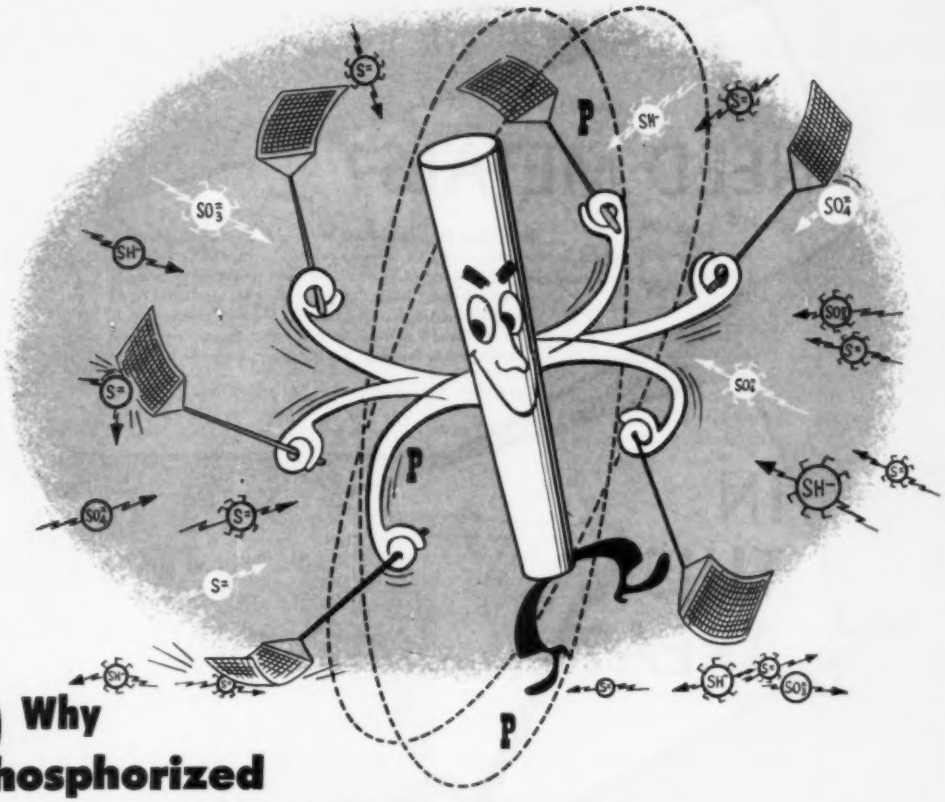


Allis-Chalmers tube-type motors are little or no larger than open motors of the same rating. Internal compartmentation divides motor into two chambers, keeping pressure at a lower level should an internal explosion occur.

Get Complete Information Now — Ask your Allis-Chalmers district office representative about tube-type explosion-proof motors in sizes up to 2000 hp with Underwriters' Labels to 800 hp. Or write Allis-Chalmers, Milwaukee 1, Wisconsin, and ask for Bulletin 51B7149.

A-3768

ALLIS-CHALMERS



Why Phosphorized Admiralty Heat Exchanger Tubes?

High Resistance to Sulfides and Other Active Sulphur Compounds

In order to assure *uniform* chemical composition and inherent *soundness*, Scovill produces Phosphorized Admiralty tubes by its continuous billet-casting process which consistently maintains the optimum amount of phosphorus. Adding as little as 0.02% phosphorus to Admiralty also gives maximum resistance to dezincification while retaining all the other desirable properties of this alloy.

Scovill's 40-page Condenser Tube Booklet is available to users who request it on their business letterhead. Scovill Manufacturing Company, 14 Mill Street, Waterbury 20, Connecticut.

Only Scovill Phosphorized Admiralty Has All These Advantages . . .

- Uniformity and soundness resulting from Scovill continuous-casting techniques
- Relative immunity to dezincification
- High resistance to sulfides and other active sulphur compounds
- Satisfactory resistance to weak mineral acids and acid mine waters
- Good resistance to velocities under 7 fps
- Excellent performance at relatively high operating temperatures
- Superior performance in fresh, salt or brackish waters

SCOVILL HEAT EXCHANGER TUBES

"You can't buy better brass"

SCOVILL

A PRODUCT OF SCOVILL

STAINLESS STEEL

ALUMINUM

NEED METALS?

MONEL*

INCONEL* BRASS

NICKEL*

COPPER

STEEL

Sheet, Plate, Tube, Pipe, Wire, Rod and Bar, Extrusions, Structural Shapes . . . and the following INDUSTRIAL PRODUCTS: Fasteners, Tube Fittings, Pipe Fittings, Valves, Silver Brazing Alloy, Welding Material, Solder, Castings, Tube Expander Equipment, Liquid Plastic Protective Coating, Metallic Caulking Compound, Aluminum Metal Trim, Waterproof Barriers, Nails, Handrail Fittings, Low Melting Alloys, Aluminum Jacketing, Wire Cloth and Rope, and "O" Rings.

Precision Equipment for Shearing and Slitting.

*Not stocked in Kansas City or St. Louis territories.

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Phone: GOodfellow 1234

Kansas City 16, Mo.
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Frank D. Hogan
Phone: NOrday 3516

Call, wire, or write nearest Metal Goods Corporation Representative:

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Scott J. Harrison
Phone: 4-1175

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Harris T. Gregg
Phone: CEntral 8881

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Arlie W. Tempel
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Baton Rouge, Louisiana
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Phone: 4-4738

Indianapolis 2, Ind.
Harry L. Newton
1333 N. Pennsylvania
Phone: Lincoln 4980

Memphis, Tennessee
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Robert W. Downs
Phone: 5-8721

Davenport, Iowa
924 State Street
Robert L. Tharp
Phone: 2-3156

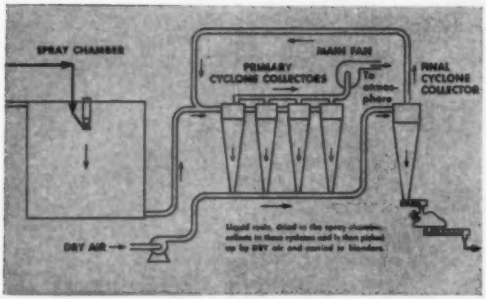
Omaha, Nebraska
3515 No. 67th Avenue
C. M. Cooley
Phone: Walnut 1112

Beaumont, Texas
238 Bowie Bldg.
L. T. Dodson
Phone: 4-7536, 4-7537

Fort Worth, Texas
3821 Caralyn
John M. Turbitt
Phone: FOrtune 4369

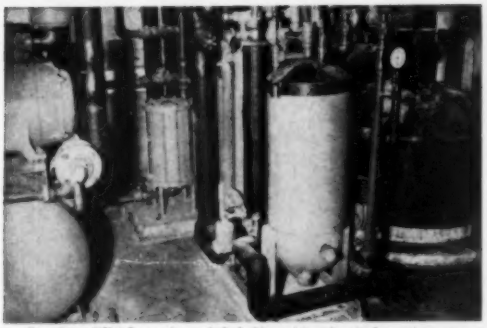
San Antonio, Texas
2012 Alamo Natl. Bldg.
Ray D. Bagaley
Phone: GArfield 3161

LECTRODRYERS are production tools at these American *Cyanamid* Plants



DRY air picks up powdered resin to keep it DRY at American Cyanamid's Wallingford, Conn. plant

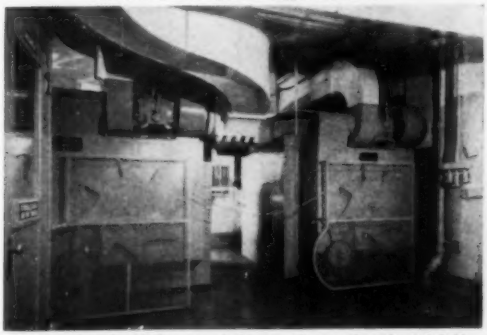
Get molding powders DRY and keep them that way; that's the function of this portion of the production line in this ultramodern plant. There's no moisture in the air that picks up molding powders as they come from the cyclones—no moisture to impair the quality American Cyanamid has compounded into these products.



Two Type BY-1 Lectrodryers help hold sensitive chemical reactions on the beam by DRYing the air supplied to controls.

On instrument air at Calco Chemical Division, Willow Island, W. Va.

No moisture gets into air lines here to condense, form ice, rust or sludge and cause trouble. Two Lectrodryers* designed especially for instrument air work, catch the vaporous moisture which aftercoolers, filters and separators let by. Calco Chemical Division's products are consistently higher in quality, therefore.



Aureomycin and penicillin are packed in a sterile area where the air is held at 6% relative humidity by these Lectrodryers.

Holding humidities constant at Lederle Laboratories Div., Pearl River, New York

Control the quality of air surrounding processes, just as you control materials going into products; this is a rule for quality production at Lederle Laboratories Division, as at the other divisions of American Cyanamid Company. Besides sterilizing the air here, Lectrodryers hold it at a constant temperature and humidity.

You probably have plenty of places where Lectrodryers will help you boost quality and speed production. For help in finding out, write Pittsburgh Lectrodryer Corporation, 307 32nd Street, Pittsburgh 30, Pennsylvania.

LECTRODRYERS DRY WITH ACTIVATED ALUMINAS

LECTRODRYER

*REGISTERED TRADEMARK U.S. PAT. OFF.

No matter how you look at a Chemico plant

it's a profitable investment

If you are thinking of expanding present facilities or erecting a new plant for the manufacture of heavy chemicals, look into Chemico's all-inclusive service.

PLANNING—All factors that may influence design . . . availability of raw materials and utilities, location of plant site, soil conditions . . . are checked before starting engineering designs. Each Chemico project is planned to meet your specific needs.

PROCESS—Chemico offers a wide range of processes for the production of heavy chemicals. Every one is proved in service . . . designed for maximum output at lowest product cost.

MANPOWER—Automatic operation, centralized control and efficient plant layout minimize manpower requirements. Maintenance is simple. Equipment is never "hard to get at" for repairs.

DELIVERY—Chemico trains the operating crew . . . turns over an efficiently operating plant on a one-contract, one-responsibility, performance-guaranteed basis.

From every viewpoint, a Chemico-built plant is a profitable investment. Proof? 37 years of successful experience in completing more than 300 installations throughout the world.

CHEMICAL CONSTRUCTION CORPORATION

A UNIT OF AMERICAN CYANAMID COMPANY

488 MADISON AVENUE, NEW YORK 22, N. Y.

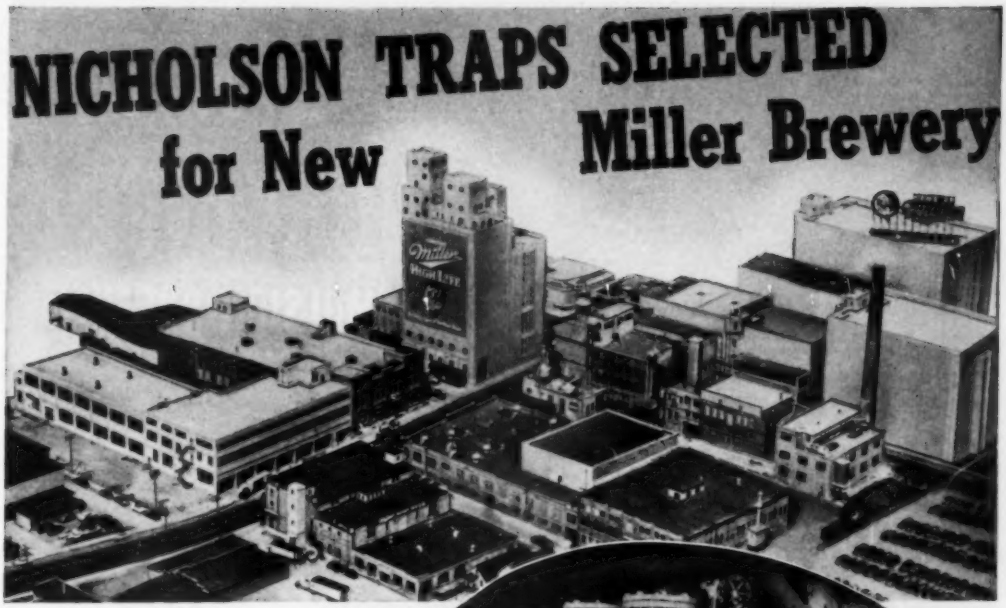
CABLES: CHEMICONST, NEW YORK

TECHNICAL REPRESENTATIVES: IN EUROPE—CYANAMID PRODUCTS LTD., LONDON; IN CANADA—CHEMICAL CONSTRUCTION (INTER-AMERICAN) LTD., TORONTO; IN SOUTHERN AFRICA—SOUTH AFRICA CYANAMID (PTY) LTD., JOHANNESBURG

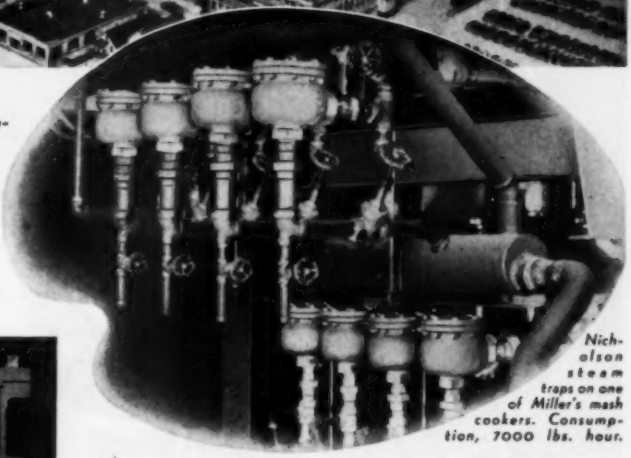
CHEMICO CHEMICAL CONSTRUCTION

Chemico plants are profitable investments

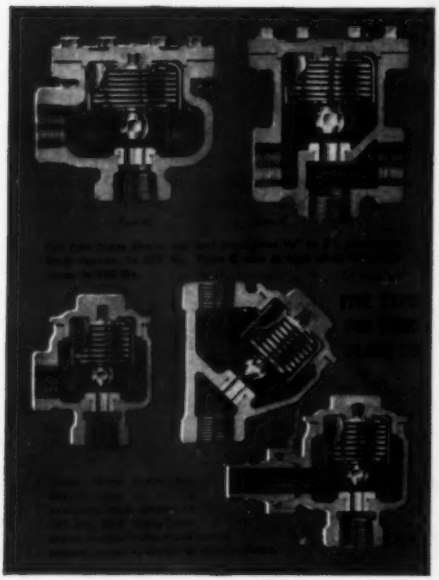
NICHOLSON TRAPS SELECTED for New Miller Brewery

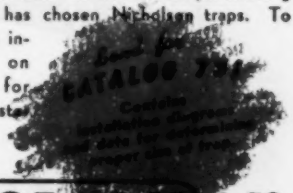


A giant $25,000,000 building program, which started in 1945, has made this Milwaukee home of nearly century-old Miller High Life beer one of the most scientifically advanced breweries in the nation. Dominated by the towering 200-feet high brew house, this vast 28-acre plant has a daily capacity in excess of 4,000,000 bottles and cans. Miller has adopted Nicholson thermostatic steam traps almost 100%. It is significant that this outstanding brewing firm, like many leaders in the other processing industries of the nation, has chosen Nicholson traps. To see why leading plants are increasingly standardizing on Nicholson steam traps for positive drainage and faster heat transfer . . . .



Nicholson steam traps on one of Miller's mash cookers. Consumption, 7000 lbs. hour.





W. H. NICHOLSON & CO.

TRAPS · VALVES · FLOATS

207 OREGON ST., WILKES-BARRE, PA.

Sales and Engineering Offices in 53 Principal Cities

55 GALLONS OF WORKING EMULSION-BREAKER

IN EVERY *Visco* BARREL!

● Putting Visco dehydrating and desalting chemicals to work for you is an absolute guarantee (in writing, if you wish) of *consistently uniform* emulsion-breaking efficiency. Every one of the big blue Visco barrels contains 55 gallons of *working* emulsion-breaker... to give you minimum cost per barrel of dry oil. Call Houston, CAPITOL 7300, collect, for prompt action or more details on Visco chemicals and field service.

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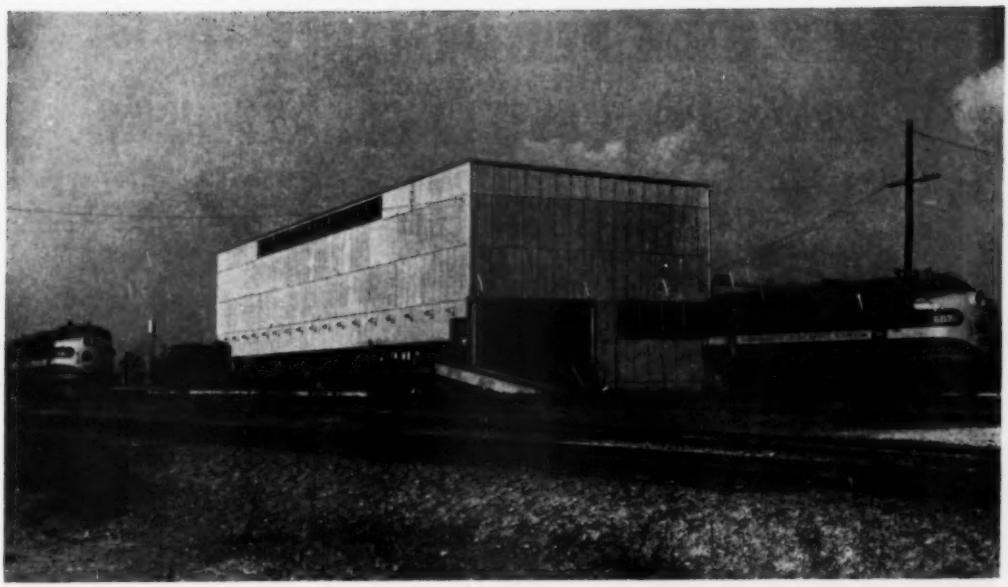
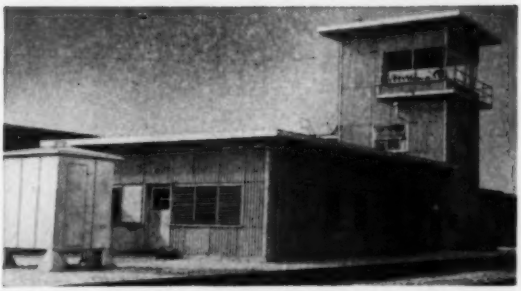
INCORPORATED
City National Bank Building
Houston 2, Texas

Visco... CONSISTENTLY EFFICIENT DEHYDRATING AND DESALTING CHEMICALS

NOTICE: Visco Products Company is authorized to manufacture and sell Visco Oil Treating Compounds for use in the breaking and resolving of oil emulsions, or to grant licenses for such use, under the following United States Letters Patent: 2,050,639; 2,050,640; 2,206,589; 2,214,783; 2,214,784; 2,225,189; 2,303,414; 2,307,813; 2,316,064; 2,318,035; 2,321,056; 2,335,554; 2,464,888; 2,514,391. Visco Products Company is willing to grant licenses on a royalty basis, to oil companies, and to others desiring to practice the patented subject matter, under any and all of the above Letters Patent, permitting the user to purchase the oil treating compounds at will from any vendor, or to prepare the compounds for use or to use the compounds under the above Letters Patent. Application for license should be made to: **Visco Products Company,** Houston, Texas.



There's no maintenance problem where you use "CENTURY" corrugated asbestos-cement sheets



Diesel Repair Shop, Signal and Control Tower at the Settegast Freight Yard of the Missouri Pacific Lines at Houston, Texas. Buildings sided with long-lasting "Century" Corrugated Asbestos-Cement Sheets. Engineers and Builders: The Austin Company

As you know, among railroading's headaches are its many maintenance jobs. Here a big one was lopped from the list, right at the start—by the use of "Century" Corrugated Asbestos-Cement Sheets . . . because roofs and siding of "Century" Asbestos Corrugated reduce upkeep to a minimum.

Buildings so constructed provide permanent protection for men, equipment, materials and finished products. "Century" Asbestos Corrugated *can not burn, rot or rust;* rodents and termites can't hurt it; it resists many chemical fumes. And regardless of climate, driving winds and deluging rains, it never needs protective painting to preserve it!

This unique material can be applied quickly, easily and inexpensively. The sheets are very strong, yet can be cut and drilled with ordinary working tools, and fastened in place with a minimum of labor.

If you are planning to construct from the ground up, or need merely to "re-cover" an old building, give earnest consideration to the outstanding money-saving qualities of "Century" Corrugated Asbestos-Cement Sheets for both roofing and siding. We'll be glad to send you complete details on request.

Nature made Asbestos . . .
Keasbey & Mattison has made it serve mankind since 1873

KEASBEY & MATTISON
COMPANY • AMBLER • PENNSYLVANIA

PRECISION PERFORMANCE of PRESSURE VESSELS STARTS HERE

Precision controlled quality starts in Midvale pressure vessels when the molten steel pours from the giant ladles in Midvale's open hearths. From then until the final machining operation skilled hands build unsurpassed performance into equipment for the petroleum, chemical and other processing industries.

Midvale's experienced craftsmen and engineers are equally skilled in producing the finest in small vessels to withstand low pressures . . . or large forged steel vessels to stand pressures up to 9000 pounds per square inch.

For precision produced forged pressure vessels, heat and corrosion resistant castings, tube supports and hangers to your most exacting specifications let Midvale make them. Our engineers are ready to help you design them . . . our experienced men working with the most modern equipment can produce them.

THE MIDVALE COMPANY
NICETOWN • PHILADELPHIA 40, PENNA.

Offices: New York, Chicago, Pittsburgh
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MIDVALE

Custom Steel Makers to Industry

PRODUCERS OF FORGINGS, ROLLS, RINGS, CORROSION AND HEAT RESISTING CASTINGS

For example, Kaylo Heat Insulation reduces inventory requirements because:

1. Wide effective temperature range —up to 1200° F.—eliminates the need for combination coverings in nearly all operating conditions.

2. Simplified Dimensional Standards allow nesting.

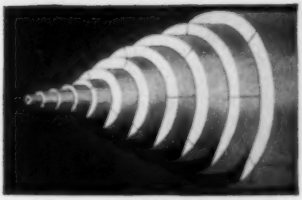
3. Unmatched selection of shapes and sizes reduces the number of pieces required per job.

Kaylo Heat Insulation reduces installation costs because:

4. The material is lightweight, strong and easily handled.

5. It is easy to cut and fit with standard tools.

Kaylo Heat Insulation is a hydrous calcium silicate—the heat-saving material that is revolutionizing insulation practice with its outstanding combination of advantages. Get all of the facts now.



Simplified Dimensional Standards mean that O. D.'s of insulation correspond to O. D.'s of standard pipes, assuring proper fit for nesting, when necessary. With this system of snug nesting, Kaylo Heat Insulation assures fits for all operating conditions, requires less items—reduces inventory stocks.

WRITE FOR FREE BOOK—"Kaylo Heat Insulation." Address: Dept. N-241, Owens-Illinois Glass Company, Kaylo Division, Toledo 1, Ohio.

KAYLO® ... *first in calcium silicate*

...*pioneered by* OWENS ILLINOIS Glass Company

MAIN OFFICE: TOLEDO 1, OHIO — KAYLO SALES OFFICES: ATLANTA • BOSTON • CHICAGO • CINCINNATI • CLEVELAND • DETROIT HOUSTON • MINNEAPOLIS • NEW YORK • OKLAHOMA CITY • PHILADELPHIA • PITTSBURGH • ST. LOUIS • WASHINGTON

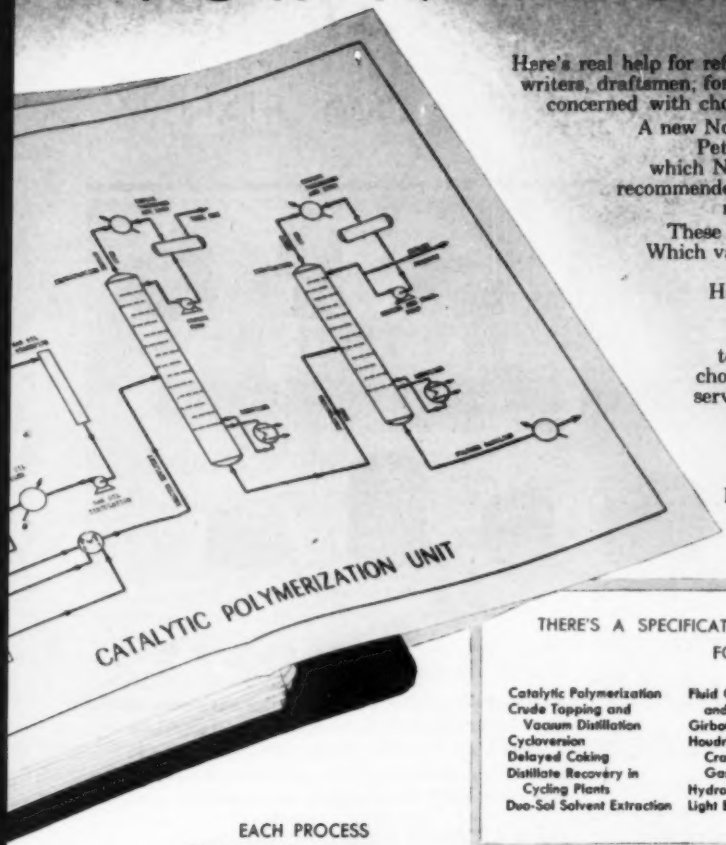
NOW . . . Complete

FIT THESE NORDSTROM TYPES TO YOUR REFINERY PROCESS

Nordstrom 2-bolt Cover Valve
(4" and smaller—Semi-Steel)

Nordstrom Valve Specifications

FOR 19 PROCESSES



Here's real help for refinery design engineers, specification writers, draftsmen; for refinery operators . . . for anyone concerned with choosing valves for refinery pipe lines.

A new Nordstrom manual "Specifications for Petroleum Refinery Services" tells you which Nordstrom valves and lubricants are recommended for each major line of flow in the most widely used refinery processes.

These specification sheets quickly answer: Which valve? Which lubricant? Size? Type? Temperature and pressure ranges? How does the valve fit into flow line? . . . every essential fact.

Ask your Nordstrom sales engineer to show you a copy. It will help you choose the *right* valve for each refinery service whether you're designing a new plant, making replacements in an old one, or building a specification list. Call your nearby Rockwell office, or write Rockwell Manufacturing Company, 400 N. Lexington Ave., Pittsburgh 8, Pa.

THERE'S A SPECIFICATION SHEET FOR EACH OF THESE PROCESSES:

- Catalytic Polymerization
- Crude Topping and Vacuum Distillation
- Cycloversion
- Delayed Coking
- Distillate Recovery in Cycling Plants
- Duo-Sol Solvent Extraction
- Fluid Catalytic Cracking and Gas Recovery
- Girbotol Process
- Houdriflow Catalytic Cracking and Gas Recovery
- Hydroforming Process
- Light Ends Fractionation
- Naphtha Polyforming
- Phenol Extraction
- Propane Deasphalting
- Propane Dewaxing
- Solexol Process
- Solvent Dewaxing
- Thermal Cracking
- Thermal Reforming

EACH PROCESS SPECIFICATION SHEET GIVES YOU THIS DATA—

1. A Simplified Flow Diagram of the Process
2. Process Conditions
3. Average Temperature and Pressure Ranges
4. Characteristics of Line Fluids and Gases
5. Recommendations for Nordstrom Valves and Lubricants

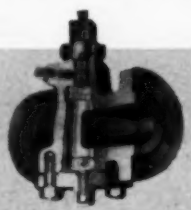
Rockwell Built Nordstrom Valves

Another Rockwell Product

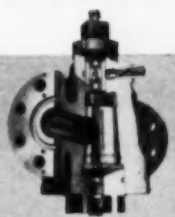
LUBRICANT SEALED TO KEEP UPKEEP DOWN

Nordstrom Standard Valve—Screwed Gland (4" and smaller—Semi-Steel and Nordco Steel)

Nordstrom Standard Valve—Bolted Gland (4" and larger—Semi-Steel and Nordco Steel)



Nordstrom Hypreseal Valve (Flanged Bottom Cover)



Nordstrom Hypreseal Valve (Screwed Bottom Cover)

WANT TO SAVE THE DIE COST

OF BUBBLE CAPS AND RISERS?

AT PRESSED STEEL CO.

DIES ARE ON HAND for 200 STANDARD STYLES

Upon request, we will send you a bulletin listing complete specifying data on 200 standard styles of bubble caps and risers furnished by The Pressed Steel Co. With dies on hand for this wide range of styles, it is entirely likely that we can save you the die costs on your bubble cap requirements. Caps to meet special needs will be promptly designed. PSC bubble caps are fabricated from the complete list of alloys which are available today. This enables us to meet any specific corrosion or coking problems. Also welded alloy tubing, conveyor flights, etc., to any design or metal specifications.

An important supplier of welded alloy equipment to the refining industry for almost a quarter of a century, Pressed Steel Co. offers you a wealth of experienced engineering assistance and production know-how. Send blue prints or write us to your needs.

NEW LE JONS BUBBLE CAP ASSEMBLY SAVES 7 WAYS

PSC bubble caps and risers are furnished for all methods of tray assembly. Included is the new Le Jons method, which features unprecedented simplicity and saves in 7 ways. Let us send you data on the 200 standard styles of PSC caps and risers, and our assembly methods.

PRESSED STEEL PSC

THE PRESSED STEEL COMPANY
of WILKES-BARRE, PENNSYLVANIA

Industrial Equipment of Heat and Corrosion Resistant WEIGHT-SAVING *Sheet Alloys*

☆ ☆ ☆ OFFICES IN PRINCIPAL CITIES ☆ ☆ ☆

KAST-SET A. P. Green KAST-SET is a rapid setting, high strength refractory castable. Mixed with water, it takes on a hydraulic bond without the application of heat. KAST-SET will not shrink, has excellent resistance to abrasion, and is ideally suited for monolithic linings. It may be used at temperatures up to 2750° F. KAST-SET is recommended for making special shapes quickly and easily, right on the job.

KAST-O-LITE A lightweight, insulating castable refractory recommended for temperatures up to 2500° F. It is used for complete monolithic linings in all types of oil stills and heaters, tar stills, air heaters, heat treating furnaces, flues and stacks, and for furnace hearth insulation. Reduces heat loss. Insures closer temperature distribution and control.

A. P. GREEN

High Quality REFRACTORY AND INSULATING CASTABLES REDUCE "DOWN TIME" AND LABOR COSTS

There is a specific A. P. Green Castable for every refractory application in the petroleum field. Methods of installation, which include troweling, pouring and "gun" application, vary with the particular characteristics of the job. Each A. P. Green castable refractory is specifically designed to provide the required properties of insulation, strength, abrasion resistance and refractoriness for high efficiency operation of petroleum equipment.

For detailed information and recommendations without obligation, write the Engineering Department of the A. P. Green Fire Brick Company . . . or call your local A. P. Green distributor.

A. P. GREEN FIRE BRICK CO.
MEXICO, MISSOURI, U. S. A.

In Canada
A. P. GREEN FIRE BRICK COMPANY, LTD.
Toronto 15, Ontario

CASTABLE INSULATION No. 20
A hydraulic-setting castable for temperatures up to 2000° F. Recommended for complete monolithic linings and lightweight panel construction in oil stills and heaters. Weighs 50 pounds per cubic foot in place.

CASTABLE BLOCK MIX
A hydraulic-setting castable insulation for temperatures up to 1600° F. CASTABLE BLOCK MIX combines the advantages of a castable material with low conductivity and light weight. It provides maximum insulating efficiency and ease of installation. Weighs only 20 pounds per cubic foot in place.

CASTABLES FOR GUN APPLICATION
SK-7 and KS-4 were designed for use in combination to form composite linings in catalytic regenerators, reactors, and other petroleum equipment. Frequently a lining utilizing only SK-7 or KS-4 will fulfill the requirements of the job. These castables are adaptable to a variety of installations, particularly in places where normal pouring castables cannot be used.

SK-7 Gun application of SK-7 produces a lightweight lining with excellent strength and insulating efficiency. Installation and labor costs are reduced — no forms required. Ideal lining for ducts, flues and breechings.

KS-4 This strong abrasion resistant castable can be gun applied with a minimum of rebound loss. Recommended for catalytic regenerator linings, stack linings, bubble towers, and duct linings exposed to abrasion or corrosion.

PROPERTIES OF A. P. GREEN CASTABLES

	Kast-Set	Kast-O-Lite	Castable Insulation No. 20	Castable Block Mix	SK-7	KS-4
Recommended for Maximum Temperature of	2750° F.	2500° F.	2000° F.	1600° F.	1800° F.	2550° F.
Amount Required per Cubic Foot, Dry	110 lb.	78 lb.	50 lb.	20 lb.	50 lb.	121 lb.

A. P. Green REFRACTORY PRODUCTS

Distributors in the Principal Cities of the World

GET

"PIN POINT CONTROL"

WITH

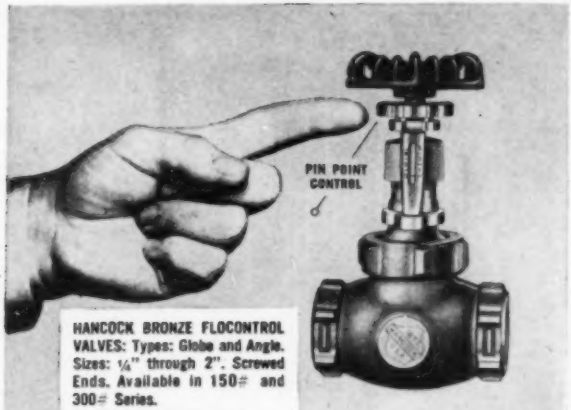
HANCOCK

FLOCONTROL VALVES

Say "good-bye forever" to filed notches, paint daubs, string tying and other make-shift ways of marking globe valve settings. With Hancock Flocontrol Valves in your lines, you can be sure of "pin point control" of flow, temperature or pressure. The sturdy micrometer dial and pointer attached to the bonnet permits settings to within a 1/100th turn of the handwheel! And, you can instantly duplicate any setting exactly, any time.

Hancock Flocontrol Valves are available in bronze and steel. Both types are strong, leak-defying valves with scientifically designed V-Port disc that *compels proportional flow throughout the entire lift of the valve stem.* Because these valves have long-wearing Acme threads, straight-line flow is not dependent on the short-wearing, fine threads of a needle valve. The seats and discs are superfinished "500 Brinell" stainless steel. Foreign substances or steam cutting effects are minimized.

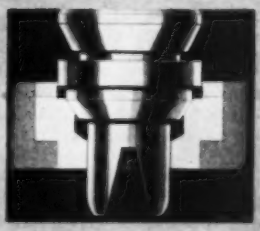
Eliminate guesswork. Minimize repairs and maintenance. Install the most efficient and economical valves you can use — Hancock Flocontrol Valves. Get in touch with your nearby Hancock Distributor for complete information.



HANCOCK BRONZE FLOCONTROL VALVES: Types: Globe and Angle. Sizes: ¼" through 2". Screwed Ends. Available in 150# and 300# Series.

HANCOCK 600# STEEL FLOCONTROL WELDVALVES: Types: Globe and Angle. Outside Screw and Yoke. Sizes: ¼" through 4" Screwed, Socket Welding and Flanged Ends. Available with 150#, 300# and 600# Series Flanges.

V-PORT DISC is scientifically designed. Shut-off seating surface is entirely removed and separate from the controlling V-Ports. Wire-drawing and cutting action are minimized. No separate shut-off valve needed. Hancock Flocontrol Valves are "2 in 1" valves. The separate seating surface on the V-Port disc gives you a shut-off valve as well as a control valve.



1877 HANCOCK U.S.A.

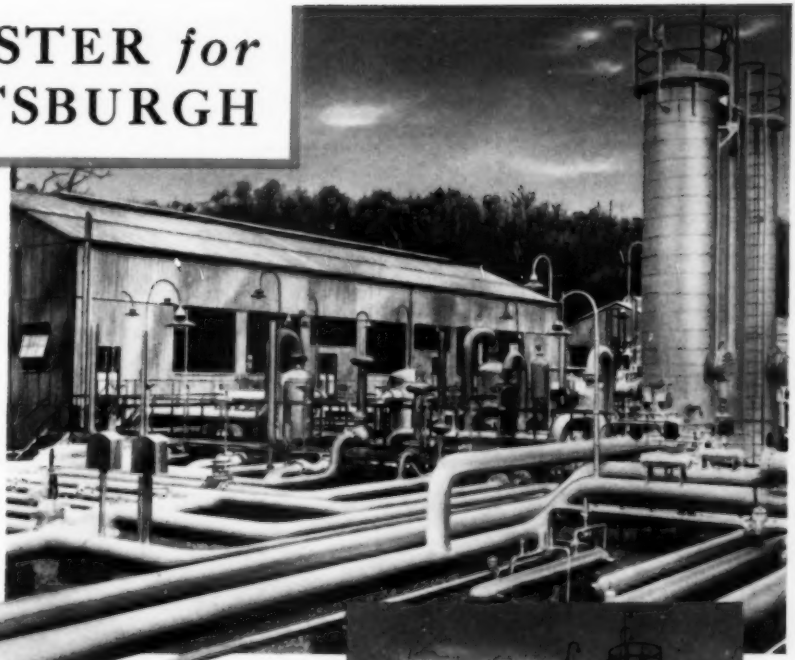
When Hancocks go in, valve costs go down

HANCOCK VALVES

A product of MANNING, MAXWELL & MOORE, INC. WATERTOWN 72, MASSACHUSETTS

MAKERS OF 'HANCOCK' VALVES, 'ASHCROFT' GAUGES, 'CONSOLIDATED' SAFETY AND RELIEF VALVES, 'AMERICAN' INDUSTRIAL INSTRUMENTS. BUILDERS OF "SHAW-BOX" CRANES, 'BUDGIT' AND 'LOAD LIFTER' HOISTS AND OTHER LIFTING SPECIALTIES.

BOOSTER *for* PITTSBURGH



The Pratt Compressing Station of the Equitable Gas Company will increase the flow of natural gas to the Pittsburgh area during periods of high demand.

Pressure is boosted; gas from a local field is compressed and delivered to the system; and gas compressed and stored underground during low periods is released as needed.

Stone & Webster Engineering Corporation was retained for the design, and supervision of construction of the Pratt Station.

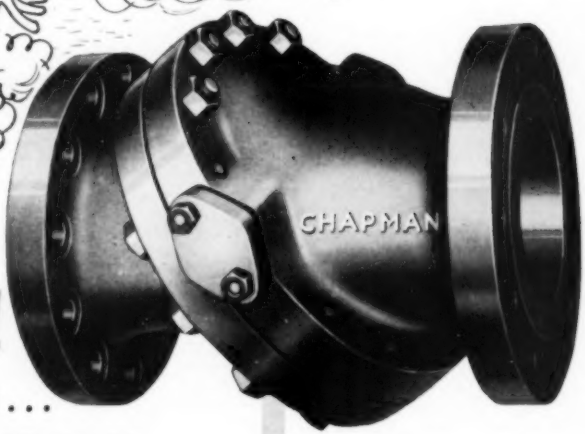
This project, consisting of compressing station and a dehydration unit, has a capacity of 52 million standard cubic feet per day.

STONE & WEBSTER ENGINEERING CORPORATION

BADGER PROCESS DIVISION

AFFILIATED WITH E. B. BADGER & SONS (GREAT BRITAIN) LTD.

Pratt Compressing Station, Waynesburg, Pa.



Complete Seating Contact!

You know you've got it with . . .

CHAPMAN

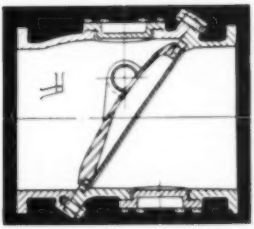
Exclusive TILTING DISC *Check Valve*

Nothing can "unseat" the disc-ring of this valve from its *drop-tight* contact with the body-ring . . . because clearance at the hinge-pins means that this contact is *complete*. There is no sliding action, consequently no wear, no leakage. And the pivoted disc is cushioned to an easy, silent closing . . . without slam . . . in installations that don't have unusual piping arrangements.

What's more, hydraulic laboratory tests at a top engineering school prove that the specially designed disc and streamlined valve-body reduce head loss as much as 80% under conventional swing-type check valves. See the graphs of these tests . . . and illustrations of the unique construction features of Chapman Tilting Disc Check Valves . . . in Catalog No. 30 (yours for the asking). *Write.*

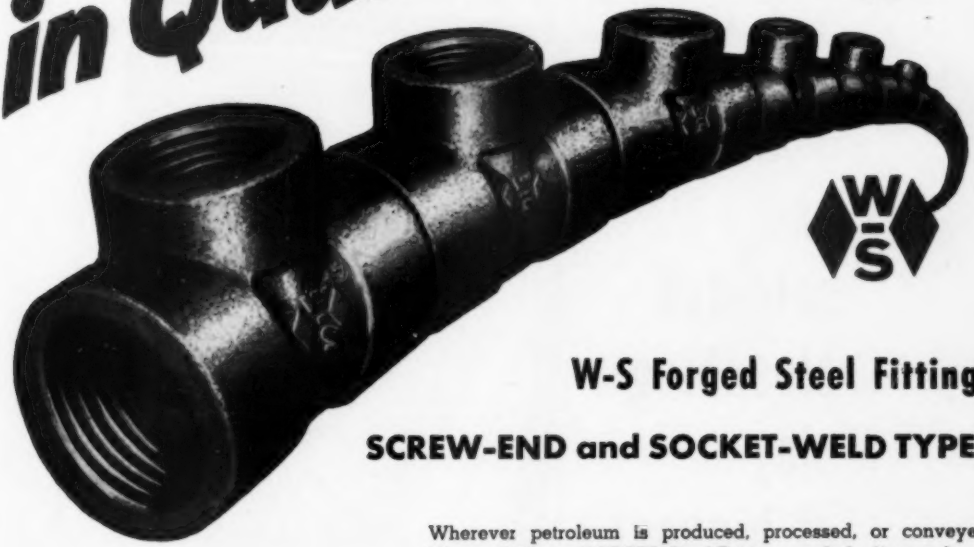
THE CHAPMAN VALVE MFG. CO.

INDIAN ORCHARD, MASSACHUSETTS



Cross-section of the Chapman Tilting-Disc Check Valve. A feature of the design is that the disc seat lifts away from the body seat when opening, and drops into contact when closing, with no sliding or wearing of the seats.

Quality... in Quantity



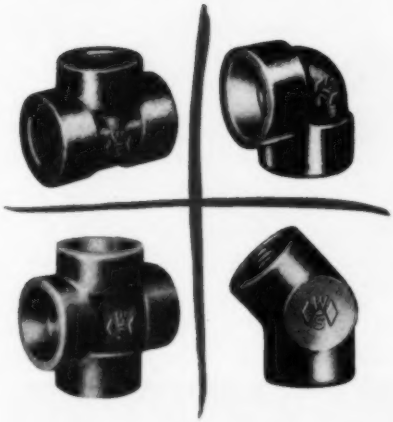
W-S Forged Steel Fittings

SCREW-END and SOCKET-WELD TYPES

Wherever petroleum is produced, processed, or conveyed, Watson-Stillman FORGED Steel Fittings mark the lines to lower operating cost and higher profits.

Quality—in Quantity—has earned and sustained the Watson-Stillman position of first-to-see when industry seeks a solution to a specific fittings problem. Despite an enormous increase in the use of its low *service* cost fittings, Watson-Stillman has never relaxed its concern for the metallurgical aspects of product development.

First to identify itself with the establishment of standards for the properties of special purpose fittings alloys, Watson-Stillman technicians continue in close association with the engineering research efforts of a score of basic industries . . . will be glad to lend a hand on *your* next fittings problem.



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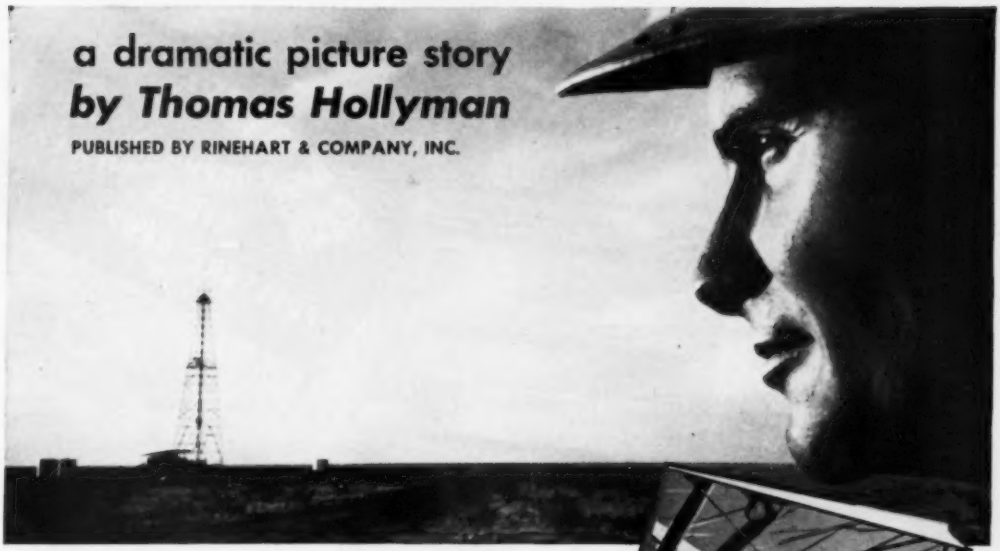

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Shell Oil Company and its employees co-operated with Mr. Hollyman to make this picture story possible—and offer this announcement as a service to the men and women who have made oil the nation's No. 1 source of energy.

"The Oilmen," published by Rinehart & Company, Inc.
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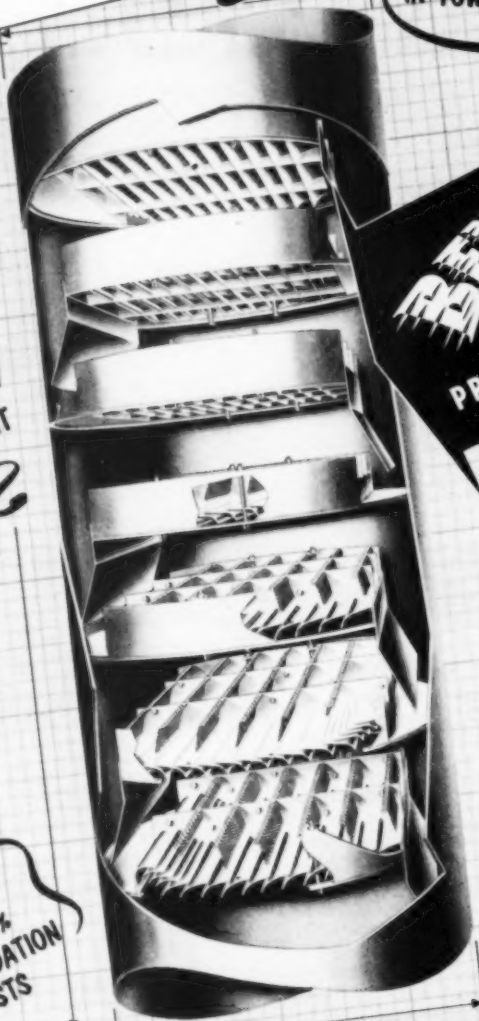

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PETROLEUM REFINER

The LOOK BOX

McKetta Is New Editorial Director

DR. JOHN J. McKETTA, chairman of the department of Chemical Engineering of the University of Texas, 1949-51, has resigned his position as professor at the University to take over the expanding editorial staff of PETROLEUM REFINER as editorial director.

Dr. McKetta, experienced in the practical aspects of chemical engineering and processing, active in the affairs of the American Chemical Society, American Institute of Chemical Engineers and American Institute of Mining and many other scientific societies, and regarded by his fellows and students as an outstanding teacher, took up his new duties with PETROLEUM REFINER on June 1.

This announcement, being made formal in this issue, was given the staff early in 1952 by Ray L. Dudley, publisher and president of Gulf Publishing Company, when William L. Bolles indicated his intention of returning to Monsanto Chemical Company in Texas City, where he had worked before taking over the editorial duties a year ago.

"We are most pleased that John McKetta has decided to come with us," Mr. Dudley declared. "He stands very high in his profession and we are sure that the brilliance he has shown as an author and teacher of engineering subjects will soon be reflected in his handling of the technical section of our magazine. He is well versed in all phases of the processing field, and is a splendid writer and organizer. Besides all this, he has a dynamic personality that will prove a great asset."

In addition to his teaching duties at Austin, McKetta has been acting as assistant director of the Texas Petroleum Research Council, a duty which he will be carrying on until his contract expires on September 1.

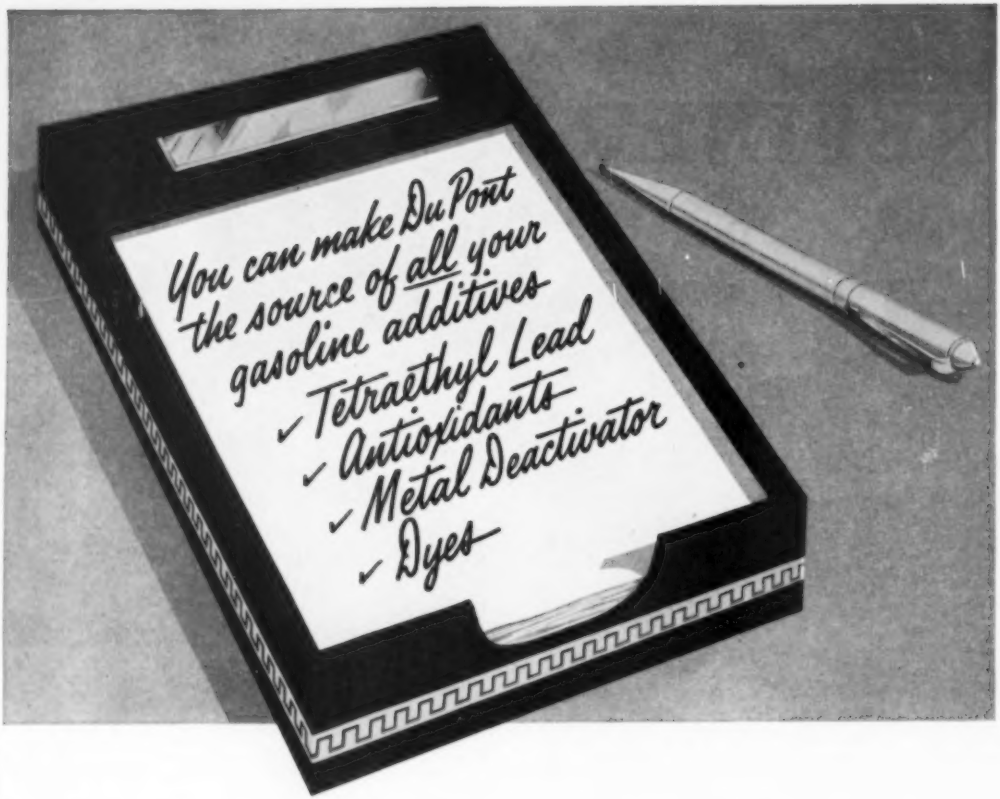
Since March 1, McKetta has spent considerable time in Houston acquainting himself with his new duties and working out staff details. Coincidentally with the announcement of McKetta's appointment was announced the addition to PETROLEUM REFINER's staff of Robert J. Phillips, who June 1 became Operation and Maintenance editor. (Detailed announcement on page 150.) George Gibbs, under the new editorial setup, has been named Process and Construction editor. Gibbs has been associate editor of PETROLEUM REFINER for nearly a year. Al Reese is special assignment editor, Gilbert Wilson is Western editor, Cecil W. Smith is economics editor, and Ben Gillespie is assistant to the managing editor. Silas B. Ragsdale continues as managing editor and Dudley as publisher.

John J. McKetta

McKetta, a native of Pennsylvania, completed his undergraduate work in chemical engineering at Tri-State College, Angola, Ind., in 1937. After four years in development and production with Wyandotte Chemicals Corporation, he served as director of chemical development with C. B. Schneible Company until he was awarded a teaching fellowship at the University of Michigan in 1942. Here he took a bachelor's degree, then a master's (1944) and his doctorate (1946) all in chemical engineering. At Texas he served as assistant professor, associate professor and professor of chemical engineering. In June, 1949 he was named chairman of the department, which rotating post he held for two years.

Author and co-author, he has published articles in many magazines including PETROLEUM REFINER. He holds membership in a half dozen professional societies, is listed in "American Men of Science," "Who's Who in Engineering," "Who Knows—and What," and "Who's Who in American Education."

The assignment of special departments to the editors of PETROLEUM REFINER follows lines which have proven most successful on *World Oil*.



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Making Up for The Shutdown

FULL EFFECTS of the United States refinery strike on supplies of petroleum products cannot be appraised until inventories can again be made. However, there can be little question that shutdown of almost 40 percent of the nation's processing capacity has hit fuel oil stocks the hardest. Now that most of the struck plants are back on stream, there seems to be no threat of a gasoline shortage. Motor fuel stocks, fortunately, had been at the highest level in history, and they apparently weathered the crisis with little difficulty.

The greatest effect on supplies will not be felt immediately, but will be in the form of threatened shortages of heating oil for the coming winter season. Prior to the strike, distillate inventories were only slightly above 1951 levels, yet prospects are good for a sharp consumption increase this winter. The gain may be as much as 10 percent over last season. Unless large quantities of distillate are manufactured between now and November, the supply problem would be very acute should the winter prove to be more severe than is normal.

In the coming fight to build up heating oil inventories, refiners have several important factors in their favor. One is that large withdrawals of motor fuel during the lay-off have made room for the heavy production that must accompany the high refining level necessary to build up distillate stocks for the coming heating oil season. The other is time—time that will prove so necessary in making up the losses.

An important boost to the situation could be given by the government's allowing higher price ceilings on heating oils. That would certainly encourage refiners to adjust their yields for greater fuel oil output at the expense of the money product, gasoline.

Refinery runs for the last half of the year will have to average between 6.9 and 7 million barrels daily to make up for the shutdown, and that rate would require nearly 95 percent of the nation's capacity. That would be 250,000 barrels per day higher than this year's average prior to the strike, and such a high level will be difficult to maintain.

Dangerous To Liberty

AT THE ANNUAL meeting recently concluded of the American Business Publications, an Association of the leading business papers of the United States, the following resolutions were adopted:

"Be it further resolved that the repeated practice of the Executive Department of the United States Government in usurping powers not assigned to it and in ignoring the checks and balances provided by Congress is hereby condemned as a tyrannical exercise of power; and be it further resolved that the seizure in question should be a matter of deepest concern on the part of every American, and the occasion for prompt action by Congress.

"Be it further resolved that the repeated practice of the Executive Department of the United States Government in usurping powers not assigned to it and in ignoring the checks and balances provided by our Constitution, is condemned as dangerous to our liberties."

PETROLEUM REFINER is in thorough accord with the thought expressed in the foregoing resolutions. Emergency by proclamation, war by subterfuge, treaty-making in defiance of the provisions of the constitution all have been pointing in a dangerous direction during the past several years.

U. S. News, in a recent article, asked if a dictatorship were possible in the United States and it answered its own question, saying "yes," provided a power-hungry President and a subservient Congress were in office at the same time.

We submit that the casualties now being incurred in Korea are the result of an international agreement having the effect of a treaty made by a power-hungry President whose hand was not called by a subservient Congress, victims of still another President who misnames a first-class war a "police action" because he has usurped the prerogative of Congress to declare war. Under the guise of expediency we have seen the checks and balances, provided in our constitution, ignored as though they did not exist. Each time the constitution's checks and balances have been ignored, a blow has been struck at the foundation of American liberties.

There is, we believe, little likelihood that any organized force now in this country will, through bloody revolution, upset our form of government, but the danger of the same thing being accomplished by the surrender of Congress and our courts to the will of one man is, to our way of thinking, a very real one. We do not think that President Truman is strong enough, mentally or politically, to be a dictator, nor do we accuse him of such ambitions, but the trend of grabbing power, and of ignoring the checks provided by the Constitution can, unless stopped, set the stage for the "strong man" whose strength would destroy us all.

"The key to the strength of the American oil industry is the driving force of competition. Even with national planning and restrictions, the nation must continue to rely on private management, and although close and full cooperation with governmental agencies is necessary in times of emergency, nothing should be done that will impair the incentive for competition in normal times."

FRANK M. PORTER, President,
American Petroleum Institute.

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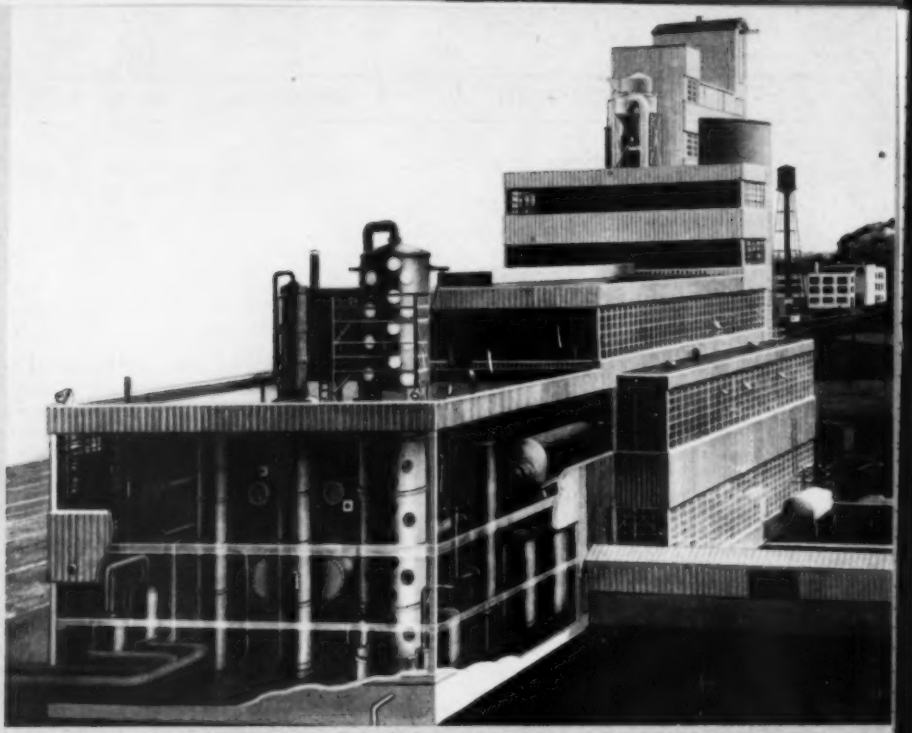

New furfural plant at Omaha showing in the foreground a cutaway view of the chemical process section.

QUAKER OATS NOW PRODUCING MORE FURFURAL

This new furfural plant at Omaha is the latest addition to the production facilities of the Quaker Oats Chemicals Department. The third and largest of its kind, it incorporates the most modern features of engineering design backed by operating experience from the first two plants. Specification furfural was produced within forty-eight hours of starting up the distillation and recovery equipment which was designed and built by Vulcan.

Important to the economics of this new plant is the recovery of substantially all the heat in the digester vapors, utilizing Vulcan's standard design steam generators. This more than supplies the heat required for the refining operation leaving a surplus available for other uses. Improvements in recovery and refining have reduced product losses and impurities to a negligible quantity.

Here is an excellent example of results achieved in chemical process design through the close integration of Vulcan's experience with that of the customer.

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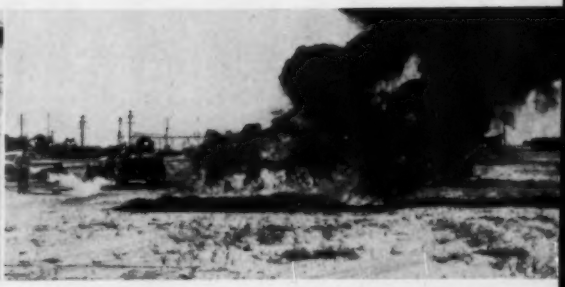

Pictures show the fire training grounds in Ponca City where all members of Continental Oil Company's fire organization are given individual training.

Job Pride Makes Continental 'Safest Oil Company in World'

Practical and extremely effective program directed by Joe Boylan had beginning in uncertain days after merger

AL REESE, Staff Writer

IT WAS a day in 1929, just after the merger of Continental and Marland oil companies, when a stocky fellow with a look of authority about him strode up to Joe Boylan in the Ponca City refinery.

"They tell me you are in charge of safety and fire protection in this plant."

Boylan agreed it was so.

"From now on, you're in charge of safety and fire protection for the whole company." And Dan Moran wheeled and marched off, leaving Boylan to wonder, among other things, where his new office was located.

Boylan found his office, all right, but he didn't bury himself there for the next 23 years, which is one reason Continental employes can claim they work for the safest company in the oil industry.

The claim is rooted in Continental's 18-year record in the annual contests of the National Safety Council. During that time the company entered 90 department contests and won 37 first-place awards and seven second-place citations. Proudest achievements came in 1951:

- Manufacturing and Marketing won first places.
- Research and Development completed the year without an accident, but was given third place because two other companies clocked more accident-free man-hours.

National Safety Council Award Won by Conoco's 1951 Record.

- Production placed sixth, Exploration eighth, and Pipe Line eleventh.
- The Ponca City refinery, with 1600 employes, entered the contest as an individual plant and accumulated more than 3 million accident-free man-hours. In recognition of this achievement, The American Petroleum Institute awarded a plaque to the refinery; the National Safety Council will bestow its highest accolade, the Award of Honor; and the Joseph A. Holmes Committee on Awards has indicated it will issue an award to the refinery.

The road to these accomplishments had its austere beginning in those uncertain days after the merger when spartan efficiency was essential.

Don't waste manpower, warned management, and ordered an expanded safety program.

Eliminate junk and clear out surplus equipment, directed management, and there came into being one of the two great pillars supporting the Continental safety code: Good Housekeeping.

Proper Maintenance

Conserve machinery, said management, and thus was erected the other great pillar: Proper Maintenance.

Here was the nucleus for a practical safety program, and a practical man was chosen to guide it. Joe Boylan had learned his painful lessons in the perilous jungles that were early day mines, railroads, and drilling rigs before he took a job in the Marland refinery at Ponca City in 1923.

Boylan's guiding principle is job pride, which he credits with the excellent 1951 safety record of the Ponca City refinery. Job pride was stimulated through a competitive plan called the Incentive Safety Program which rewards outstanding records. Personnel of the refinery are zoned into groups of 90 to 100 men. Each group completing 200,000 accident-free man-hours (about a year's work)

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This picture of the interior of pump room at Ville Platte gasoline plant, Ville Platte, La., gives an idea of the careful maintenance and good housekeeping that play a big part in Conoco's safety program.

is given a dinner. Upon the completion of 400,000 accident-free man-hours, and again upon the completion of 700,000, the dinners are repeated and employes permitted to bring their wives. When a zone completes a million accident-free hours, the employes bring their wives to another dinner and each employe pockets a $10 bill.

For other refineries of less numerous personnel this plan has been modified by giving a dinner for employes and wives upon completion of each 12 consecutive months of safe operations. The Pine Line department has a dinner for employes and wives after each 200,000 accident-free man-hours or one year of safe operations, whichever comes first. If a district compiles a million man-hours, or five years, without an accident, a $10 award is given each employe at the recognition dinner.

Job pride is also paramount in the treatment of the individual. A man caught without safety goggles in violation of the rules may be punished only by a small gift—a glass eye dropped into his palm. Neglect in an installation is for Boylan a reason to issue a soft hint that can become a reprimand if the offense is repeated. It is never an excuse to write a complaint that must trickle upstairs and then plummet down again upon the head of the sometimes unsuspecting supervisor.

"Give a man a chance and he'll take pride in his job and do it well," says Boylan in paraphrase of "Decentralization," the favorite word of President L. F. McCollum, whose outspoken belief in the value of a strong safety program is shared by other Continental executives.

The decentralization policy is evident throughout the entire safety setup. Boylan and Carl B. Adams, the assistant director of safety, have settled the task of assisting in regional safety upon four safety engineers. (The phrase "safety supervisor" is avoided as denoting the duty to direct rather than the privilege to suggest.) These four are Jim Fitzgerald at Ponca City (Central Region), Glen Apple at Denver (Rocky Mountain Region), Ted Steible at Fort Worth (Southwest Region), and Red Evans at Houston (Southern Region).

The safety engineers make property inspections, give driver tests, make accident investigations, and assist with safety meetings. Responsibility for these monthly sessions is vested in the area or plant supervisor, who frequently delegates the obligation to others under the policy of giving all employes the opportunity to conduct meetings.

Leadership at the meetings improved with the inception of a training program course on Conference Leadership Technique. Besides improving the leadership technique of the supervisors, the one-week course has given the Safety Division an excellent opportunity to make the supervisors, more familiar with the safety program.

Material for the meetings is drawn from practical knowledge and experience gained throughout the years: from information furnished by the National Safety Council, API and Bureau of Mines; and from newspaper and magazine articles.

Coordination in presenting material is achieved with a safety meeting outline book. The book for the first half of 1952 contains material On Inspection of Hand Tools, Handling of Materials, Industrial Sanitation, Protec-

Foamite Pump Room of No. 1 Fire Station, Ponca City refinery. Three types of power are provided—electric, steam, and gasoline—so pump can be switched to another power source in case of power failure.

tive Clothing, Goggles, and Automobile Accidents. A book on six other subjects will be distributed in June. Slide films and movies are sometimes used.

One of the most popular instruments in the program is *The Profitaker*, a six-page, homespun publication begun 23 years ago and published monthly ever since. Written in a light, readable style that sugar-coats its instructive intent, *The Profitaker* offers articles on industrial safety, driving safety, and general health topics. It is read by 85 percent of Continental's employes.

If there is a single element in the Continental safety setup that could be called the bulwark of the program, it is an exhaustive 207-page handbook called "Make Safety a Habit." Brought out in 1935, it has been revised four times and is to undergo another revision this year. The book originally represented a symposium of the ideas of workers, executives and safety officials, and it remains so. A safety meeting will be held in each area during the last half of the year at which each employe will be asked for suggestions and criticisms to be recorded for possible inclusion in the new edition.

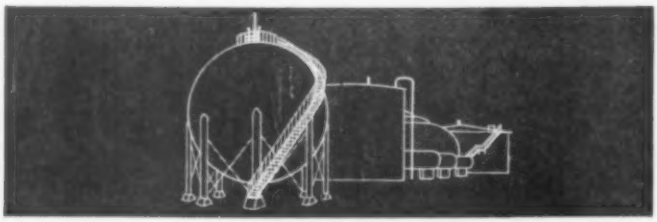
The manual covers the safety subject so simply and thoroughly that several companies have used it as a pattern for their own manuals and for reference purposes. A government agency last year asked for 50 copies, explaining that the book was to be used as a standard for safety operations.

The manual has an 86-page general section which is required reading for all employes in addition to the part devoted to each worker's department. Every copy of the manual contains a receipt by which each new employe attests that "I have read the General Section and that section devoted to my department, and am prepared to answer questions about safe practices on my job. I fully understand and will follow all the rules. I am going to MAKE SAFETY A HABIT." The signed receipt goes into the personnel file kept on each employe.

Continental folk believe their program as a whole, and the manual in particular, have not only made their company a safe place to work, but have fostered family and community safety. Concrete and dramatic evidence of this was offered some years ago in West Texas. As subsequently chronicled in a national picture magazine, two boys, 11 and 8, the sons of a Continental pumper, strayed into a restricted area. The older boy was overcome by gas. The younger ran for help and returned with his 13-year-old sister, who dragged the unconcious lad out of the gaseous area and revived him by applying artificial respiration for 35 minutes.

She, like many another child of the Continental family, had studied the safety manual.

* * *



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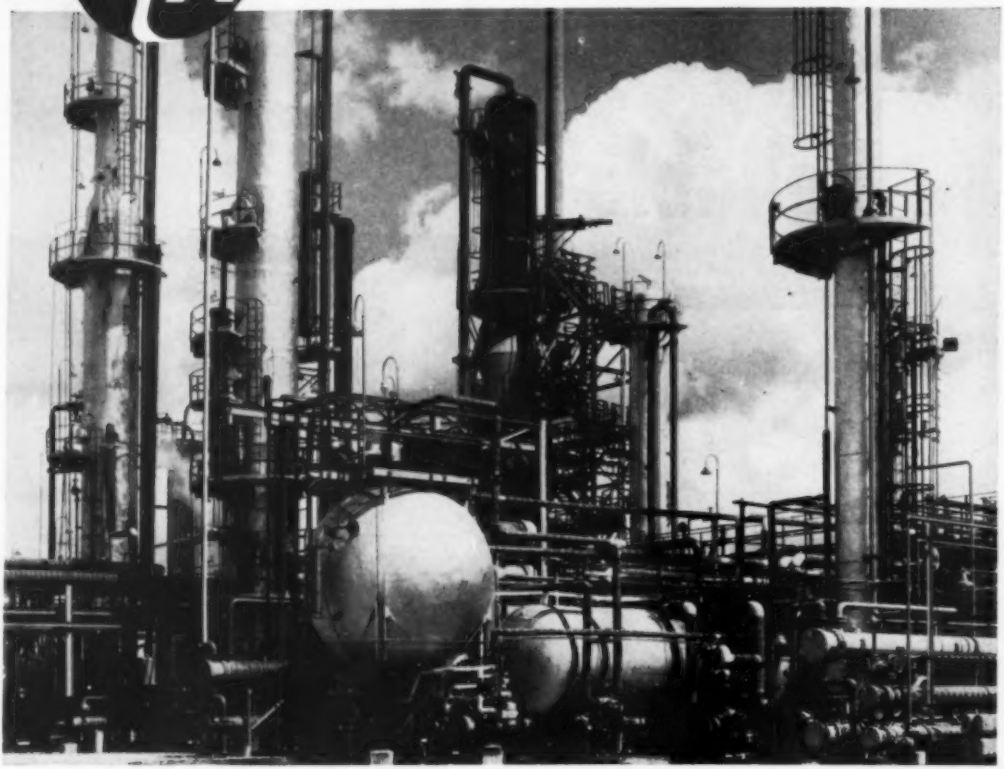

At Edmonton, Alberta, The British American Oil Company Limited has recently put into service a complete new refinery. Intended to handle production from Canada's great western oil fields, this new British American installation incorporates the most modern developments in refining technology. Like other leading refiners everywhere, British American at Edmonton relies on Petreco for desalting.

The Petreco desalter illustrated above desalts 5200 barrels per day of Redwater crude, with salt removals ranging from 94% to 96%. The electrosphere is one of Petreco's new high-efficiency, high-throughput spheres, eleven feet in diameter.

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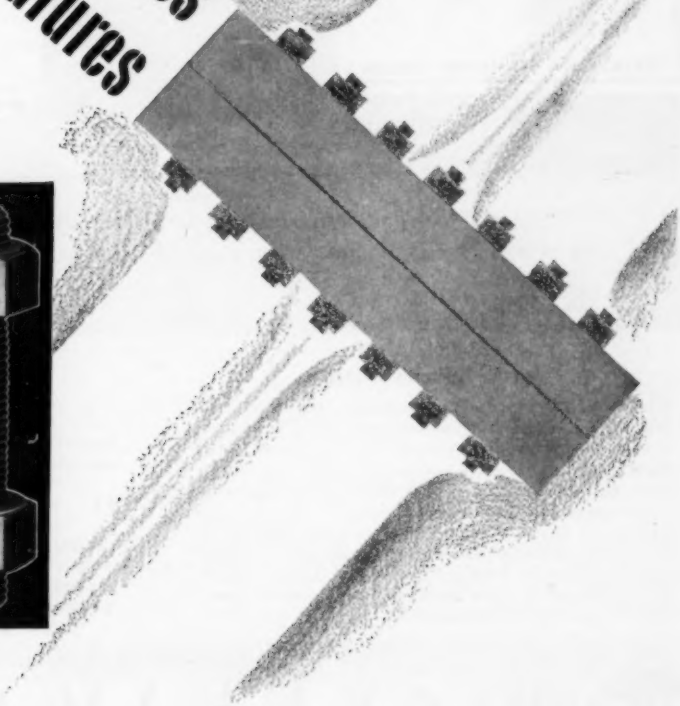
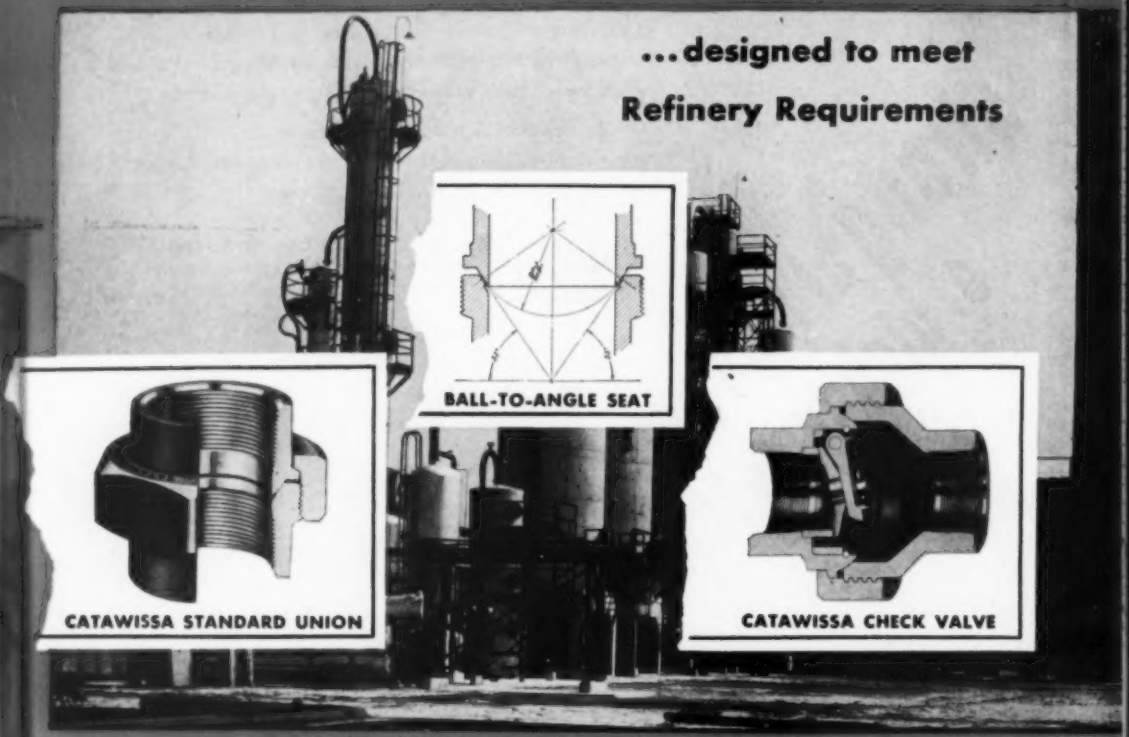


Always specify "CATAWISSA" Unions and Check Valves



"OILWELL'S" strategically located refinery stock points carry complete lines of Catawissa forged-steel unions and check valves that meet the most severe refinery specifications.

CHECK THESE FEATURES

HOT-FORGED . . . from solid, rectangular steel bars, Catawissa Unions are free from sand and blow holes. They will expand and contract with the pipe, assuring tight joints.

THREADS—Catawissa Unions and Valves are supplied with either full ACME threads or U. S. Standard V-threads in the union nuts and on the female end.

SEATS . . . in all Catawissa Unions are a 55° angle on the female end to a BALL on the male end, assuring a perfect seal even when the pipe is not perfectly aligned. Carefully hand-ground seats which require no packing are inspected and tested under water to assure holding qualities.

Contact your nearest "Oilwell" representative—to assist you with your refinery problems.

OIL WELL SUPPLY DIVISION
UNITED STATES STEEL COMPANY

Executive Office—DALLAS, TEXAS
Export Office—
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Area Offices — CALGARY, CANADA
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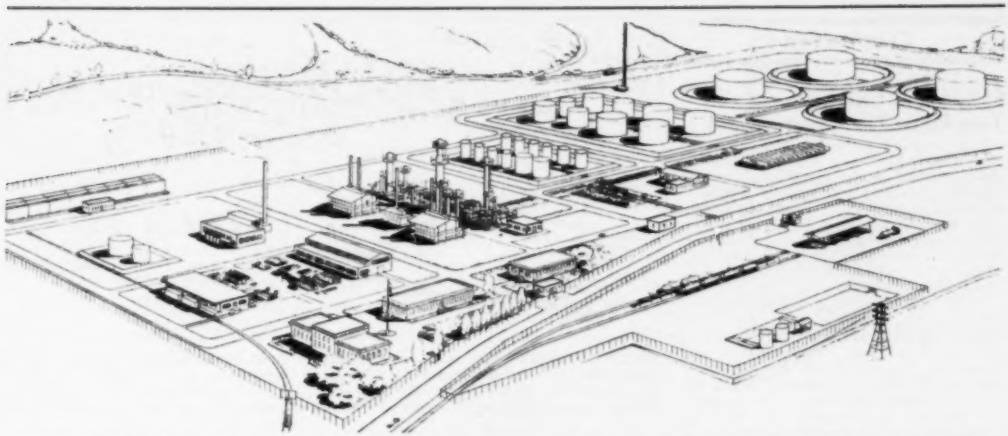
Branches Serving All Oil Fields

USS "OILWELL"

UNITED STATES STEEL



CHILEAN CONSTRUCTION SOON—Engineering studies are currently underway on Chile's first refinery (isometric drawing, above) which will be built by The M. W. Kellogg Company for Empresa Nacional Del Petroleo near Valparaiso. Construction on the $10-million plant is scheduled to begin sometime this fall. The refinery, a complete 20,000-barrel-per-day plant, will employ the most modern type of combination thermal processing equipment to produce several petroleum products from either indigenous or imported crude oils. Products from the plant will include, aside from liquefied petroleum gases, motor gasoline, kerosine, two grades of diesel oil and heavy fuel oil. Process facilities in the unit comprise crude oil distillation, vis-breaking, thermal reforming, thermal cracking, gasoline stabilization and treating equipment for sulfur removal from fuel gas, liquefied petroleum gases and gasoline.

News Notes On Refinery and Other Plant Construction

Petroleum Refiner's *quarterly "Box Score"*

feature appears next in the July issue

Gas Compressor Plant Under Construction in South Texas

Construction is underway on a casinghead gas compressor plant to serve oil wells in the Helen Gohlke area of DeWitt and Victoria counties in south Texas. A multiple ownership project with four companies participating initially, the plant will be constructed and operated by the Shell Oil Company. Other participants are the Humble Oil & Refining Company, Kirby Petroleum Company and Monterey Oil Company of Texas. The plant will contain 2640 compressor horsepower and is expected to handle up to 12 million cubic feet of casinghead gas daily. The O. L. Olsen Company of Houston has been awarded the construction contract and completion is expected by November of this year.

Small Utah Association To Boost Refining Capacity

A four-year expansion program is planned by the Utah Cooperative Association to increase crude capacity of its Jensen, Utah, refinery from 23,000 to 70,000 barrels per month. A catalytic cracking unit is among the new facilities to be added.

Indiana Standard Stockholders Learn of Hiked Plant Capacity

At a recent stockholders meeting of the Standard Oil Company (Indiana) the company announced its confidence in the Williston Basin is indicated by the fact that it is planning to build a refinery in North Dakota to handle basin oil. Its capacity at present is set at 15,000 barrels daily, but will be boosted later to 30,000. Its establishment will necessitate a crude oil pipeline from the oil fields to the refinery and probably later a products pipeline from the refinery to the Fargo-Moorhead area, which is the terminus of the company's northwest products pipeline from Whiting, Ind.

Construction Gets Underway On Synthetic Ammonia Plant

Groundbreaking ceremonies at Ventura, Calif., recently marked the start of construction of a new plant for the production of ammonia by Shell Chemical Company. The company, which already operates an ammonia plant at Pittsburg in the San Francisco-Oakland Bay area, announced that its new Ventura installation is primarily designed to give better service to growing demands in Southern California for ammonia fertilizer. When in operation, the new plant will produce 150 tons of anhydrous ammonia a day. Raw materials will be natural gas, water in the form of steam, and air. Natural gas, which will be consumed at the rate of ten million cubic feet per day, will come from nearby producing wells of Shell Oil Company. Contractors for the plant are M. W. Kellogg Company and Gibbs & Hill, Inc.

Iraq Petroleum To Expand Facilities At Tripoli Plant

Following an agreement to more than triple payments to the Lebanon government for permission to have its pipe lines pass through the country, the Iraq Petroleum Company has also promised to expand its Tripoli refinery to satisfy Lebanon's oil needs. The new contract must now be ratified by the Lebanese parliament.

Under the new deal, Lebanon's revenue will be raised from the equivalent of $680,000 to over $2 million a year for the company's two pipe lines which stretch from Iraq through the Middle East to Tripoli, Syria. Meanwhile, the government's negotiations for a new pact with Trans-Arabian Pipeline Company were said to be reaching their final stages.

RFC Loan Approval Sought For Two Refining Projects

Defense loan applications for the construction of two multi-million dollar refining projects have been filed with the Reconstruction Finance Corporation. Avgas Refining Company of San Antonio, Texas, is seeking about $10 million for a proposed 10,000 barrel-per-day refinery, while Tidewater Terminals Company of San Francisco has applied for almost $14 million for establishing 740,000-barrel marine bulk storage facilities in conjunction with a refinery.

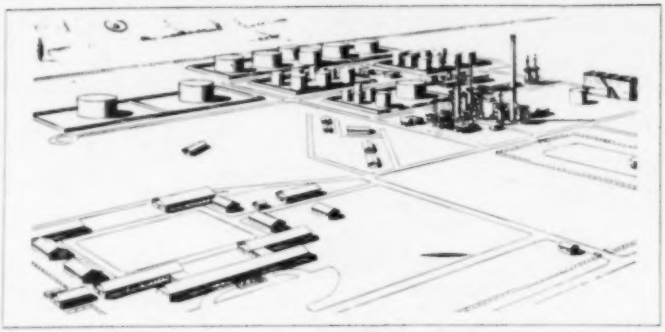
$12-Million Union Project Tops Rapid Tax Amortizations

A $12-million dollar benzene and toluene project by Union Oil Company of California at Wilmington, Calif., has been approved by the Defense Production Administration for rapid tax write-off purposes, topping a list of 34 petroleum or related projects approved by the DPA from May 2 through May 15. Refining or related projects in the 35 approved include:

Southwest Gas Producing Company, Dubach, La., gasoline, $1,690,900 at 90 percent; $2,080,700 at 65 percent; $188,500 at 40 percent. Phillips Petroleum Company, Borger, Texas, natural gasoline, $1,323,000 at 65 percent; $1,035,000 at 50 percent; $412,000 at 40 percent. Continental Oil Company, Ponca City, Lubricating oil detergent and inhibitor, $326,310 at 25 percent; $388,942 at 50 percent; $328,219 at 40 percent; $645,640 at 15 percent.

Shell Oil Company, Martinez, Calif., motor gasoline, $242,000 at 65 percent. Douglas Oil of California, Paramount, Calif., gasoline, $203,991 at 65 percent; $128,592 at 45 percent; $33,000 at 40 percent. Tide Water Associated Oil Company, Avon, Calif., gasoline, $350,000 at 90 percent; $850,000 at 65 percent. Honolulu Oil Corporation, Taft, Calif., gasoline, $144,827 at 65 percent; $53,172 at 25 percent.

Further projects approved are shown in the accompanying table.



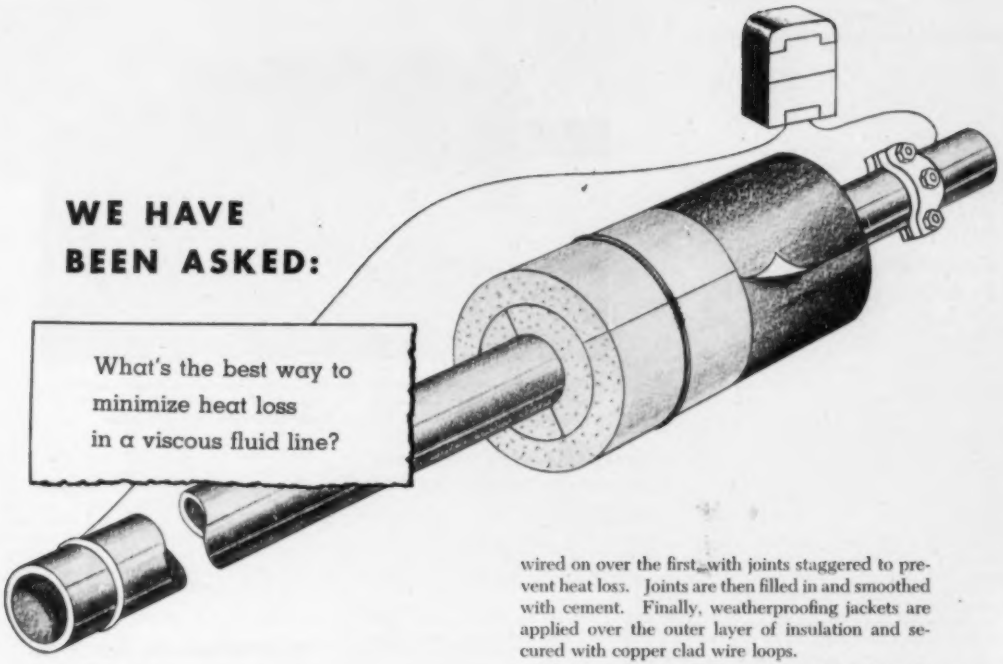
AFRICAN REFINERY—Above is an artist's conception of the 15,600 barrel-per-day fuel products plant to be constructed near Durban, South Africa, by Standard-Vacuum Oil Company. The cornerstone was laid on April 25. The Process unit combines crude distillation, catalytic cracking and thermal reforming. At lower left can be seen the administration buildings. The site covers 285 acres.

Procon Develops New Service For Platformer Construction

Procon, Inc., has announced that the company can now provide file-to-field construction on Standard A, B and C Platforming units of 600, 1000 and 1500-

Fast Tax Write-Offs Granted by DPA April 3 to May 1

COMPANY AND LOCATION	Type of Facility	Amount Amortization Certified	Percent Allowed
Socony-Vacuum Oil Co., Paulsboro, N.J.	Synthetic Bead Catalyst	$1,618,000	75
	Sulfur	325,000	50
Esso Standard Oil Co., Linden, N.J.		1,290,000	70
		260,000	40
California Refining Co., Perth Amboy, N.J.	Gasoline	103,000	40
		572,000	65
Sinclair Refining Co., Wellsville, N.Y.	Lubricating Oils	32,000	40
		810,000	65
Sun Oil Co., Marcus Hook, Pa.	Gasoline	1,930,400	65
		469,600	90
Elk Refining Co., Falling Rock, W.Va.	Motor Gasoline	750,000	65
Lakeside Refining Co., Kalamazoo, Mich.	Gasoline	277,500	65
		128,500	40
		25,000	15
Petrolite Corp., Lima, O.	Desalting Crude Oil	37,218	65
Petrolite Corp, Cleveland, O.	Desalting Crude Oil	75,536	65
Standard Oil Co. (Ohio), Lima, O.	Propane and Butane	1,050,000	65
Sun Oil Co., Toledo, O.	Gasoline	5,063,000	65
		1,332,000	40
Old Dutch Refining Co., Muskegon, Mich.	Gasoline and Fuel Oil	2,730,000	65
		165,000	50
Keystone Oil Refining Co., Detroit, Mich.	Petroleum Products	525,000	65
Western Reserve Refining Co., Niles, O.	Gasoline	95,000	65
		150,000	40
Cities Service Oil Co., East Chicago, Ind.	Gasoline	130,700	90
		12,000	50
Standard Oil Co. (Ind.), Wood River, Ill.	Heavy Duty Motor Oil	155,000	65
		25,000	50
Sinclair Refining Co., East Chicago, Ind.	Petroleum	237,000	40
Standard Oil Co. (Ind.), Wood River, Ill.	Petroleum Products	1,940,700	50
Carter Oil Co., Billings, Mont.	Butylene-Propylene Polymer	845,000	65
Farmers Union Central Exchange, Laurel, Mont.	Gasoline	2,944,899	65
		435,409	45
Socony-Vacuum Oil Co., Augusta, Kan.	Gasoline	475,500	90
		2,292,000	65
		237,500	45
Hugoton Production Co., Grant, Stephens Counties, Kan.	Natural Gasoline Distribution	422,000	40
American Liberty Oil Co., Mt. Pleasant, Tex.	Gasoline	2,125,000	65
		315,000	45
Skelly Oil Co., Longview, Tex.	Gasoline	1,044,000	65
		50,000	45
Mid-Continent Petroleum Corp., Tulsa Co., Okla.	Gasoline	187,000	65
Universal Oil Products Co., Mooringsport, La.	Components for Benzine, Toluene	594,000	75
		119,000	50
		337,000	15
Shamrock Oil & Gas Corp., Sunray, Tex.	Dry Gas, Gasoline, Gasoil and Coke	640,427	65
		19,550	50
Warren Petroleum Corp., Garvin Co., Okla.	Natural Gasoline & Residue Gas	341,765	65
		286,064	40
Magnolia Petroleum Co., Beaumont and Corpus Christi, Texas	Gasoline	732,000	90
		7,820,800	65
		2,496,200	40
Sid Richardson Gasoline Co., Winkler Co., Texas	Sulfur	177,350	70
Pan-Am. Southern Corp., New Orleans, La.	Gasoline	1,631,000	65
		25,000	15
Humble Oil & Refining Co., Baytown, Tex.	Petroleum Products	50,000	65
Humble Oil & Refining Co., Baytown, Tex.	Isobutane & Propylene	298,000	65
Continental Oil Co., Ponca City, Okla.	Gasoline	922,400	50
		618,600	35
Gulf Oil Corp., Port Arthur, Tex.	Gasoline	143,246	65
Petrolite Corp., Port Arthur, Tex.	Desalting Crude Oil	40,728	65
Petrolite Corp., Borger, Tex.	Desalting Crude Oil	91,183	65
Petrolite Corp., West Lake, La.	Desalting Crude Oil	40,774	65
Phillips Oil Co., Phillips, Tex.	Motor Fuel	77,000	65
		236,000	40
The Texas Co., Port Arthur, Tex.	Gasoline	3,100,000	90
		8,770,000	65
		3,830,000	45
Peteo Corp., Marrero, La.	Gasoline	1,770,000	65
		140,000	40
		31,000	15
Phillips Oil Co., Phillips, Tex.	Gasoline	393,000	20
		44,500	40
		1,007,000	65
		21,500	90
Phillips Oil Co., Sweeny, Tex.	Petroleum Products	308,500	65
Tex-Harvey Gasoline Plant, Midland Co., Tex.	Natural Gasoline	948,561	65
		425,785	40
Shell Oil Co., Harris Co., Tex.	Ethyl Chloride	2,645,000	50
		75,000	15
Stanolind Oil & Gas Co., Pettus, Tex.	Isobutane	161,400	90
Phillips Petroleum Co., Carson, Gray Cos., Tex.	Natural Gasoline	306,000	40
Phillips Petroleum Co., Texas Co., Okla.	Natural Gasoline & Gas	249,153	40
Phillips Petroleum Co., Upton Co., Tex.	Natural Gasoline	2,366,945	40
		9,330,800	65
Esso Standard Oil Co., Baton Rouge, La.	Petroleum Chemical Products	8,780,000	65
		1,790,000	50
		3,466,000	35
		697,000	15
Phillips Petroleum Co., Borger, Tex.	Gasoline	78,670	45
Gilcrease Oil Co., Meraux, La.	Gasoline	525,000	40
		1,055,000	65
Phillips Oil Co., Phillips, Tex.	Motor Fuel	152,500	90
		23,500	65
		180,000	25
		20,000	15
Inland Refining Co., Tucker, Tex.	Gasoline	243,000	65
The Pure Oil Co., Andrews Co., Tex.	Natural Gasoline	882,700	65
Shell Oil Co., Deer Park, Tex.	Petroleum Products	1,300,000	50
Petrolite Corp., Port Arthur, Tex.	Refining of Crude Oils	63,678	65
Atlantic Refining Co., Atreco, Tex.	Gasoline	121,500	40
		1,011,900	65
The California Co., Rangely, Colo.	Butanes & Natural Gasoline	671,152	65
The Bay Petroleum Corp., Denver, Colo.	Butanes & Butylenes	1,546,800	65
		167,700	45
Shell Oil Co., Wilmington, Calif.	Benzene	100,000	90
General Petroleum Corp., Los Angeles, Calif.	Aviation Gasoline	1,810,700	45
		7,979,300	65
		732,000	90



WE HAVE BEEN ASKED:

What's the best way to minimize heat loss in a viscous fluid line?

We recently received a letter which posed this problem:—"How should we insulate a 3" outdoor pipe line which carries asphalt approximately one thousand feet from a storage tank to the processing operation? The asphalt leaves the heated tank in a fluid state at 450° F. and must be kept above 435° F. to insure proper flow."

With this great length of pipe, insulation alone cannot be expected to hold the temperature above the 435° minimum. Should occasional shutdowns occur, no practical amount of insulation will prevent the asphalt from solidifying in the line, particularly in cold weather. Some method of applying heat to the pipe such as charging it with low voltage electricity or using a steam tracer line is recommended. This will keep the pipe warm enough to maintain proper temperature and keep the asphalt fluid, regardless of interruptions in the flow. The line should then be insulated with Double Standard 85% Magnesia according to standard specifications.

The pipe covering is applied in two layers, the first being securely wired in place. The second layer is wired on over the first, with joints staggered to prevent heat loss. Joints are then filled in and smoothed with cement. Finally, weatherproofing jackets are applied over the outer layer of insulation and secured with copper clad wire loops.

85% Magnesia is ideally suited to this and a variety of other jobs for temperatures up to 600° F. It has proved its outstanding insulation efficiency and durability through years of trouble-free service. It offers great mechanical strength, will give top performance even under severe conditions. Yet it is lightweight, easy to apply, and completely fireproof.

Next time you're up against any insulation problem, contact your near-by Armstrong office. The technical advice of an Armstrong engineer is always available to you with no obligation. The Armstrong organization can take over the entire job for you—furnish the correct materials for your particular job and the skilled workmen to apply them properly. Our complete insulation service can save you time, trouble, and money—and you'll be **sure** of having a thoroughly professional job!

SEND US YOUR QUESTIONS. If you have any question on insulating materials or their use in high-temperature installations, please write us. We'll see that you get a prompt, practical answer. Just address your letter or post card to Armstrong Cork Company, 7506 Maple Avenue, Lancaster, Pennsylvania.

ARMSTRONG'S INDUSTRIAL INSULATIONS

MATERIALS - INSTALLATION

FOR ALL TEMPERATURES FROM 300°F. BELOW ZERO TO 2800°F.

barrel per day design capacities from drawings already in the company's engineering files. Under the new plan, no time is required for detail design work and no extended interval between contract and construction. Actual capacities of these Standard Platforming units will vary according to feed stocks and methods of operation, but the range of sizes permits the selection of a capacity best suited to the individual refiner.

Coryton Refinery Expects To Be On Stream Early 1953

Vacuum Oil Company's new Coryton refinery in England is expected to be on stream by early 1953 with the first and most difficult stage of construction already complete. The preparation of the site presented a major civil engineering task which involved the laying of more than half a million tons of gravel to level the ground, and the driving of some 10,000 piles to support the building construction which will be located on ground lying eight feet below the level of the Thames. The plant will include a two-stage crude distillation unit, a Thermofor catalytic cracking plant, a thermal reformer, and motor spirit treating unit. On the lubricants side the equipment will consist of a propane deasphalter, a furfural treating unit, methyl ethyl ketone dewaxing plant and a percolation unit for clay contacting.

Hercules Builds New Jersey Hydrocarbon Chemicals Plant

Hercules Powder Company will build its new hydrocarbon chemicals plant on a 275-acre tract near Gibbstown, N. J. The new plant will be located on the Delaware river, slightly northwest of Gibbstown, and will represent an investment of nearly $8 million. Construction will start late this year, or early next year, depending upon the availability of building materials. The plant will produce phenol, para-cresol, acetone, and cymene alcohols, and will cover about 60 acres of the tract. The additional acreage will provide for future expansion. The plant will produce phenols by a new process developed by Hercules at the company's experiment station near Wilmington and at its Brunswick, Ga., plant. The new departure in phenol manufacturing centers around the production of organic hydroperoxides as the basic intermediate step in converting hydrocarbons into phenols and cresols.

Jefferson Chemical Plans Major Laboratory Addition

Jefferson Chemical Company has approved a major addition to its present laboratory buildings in Austin, Texas. Tentative plans call for a two-story laboratory building of concrete and hollow tile construction. This is the second expansion in what Jefferson expects to be a series of additions to its Research and Development facilities during the coming years. According to present estimates ground will be broken for the new construction during the fourth quarter of this year. The building will provide bench-scale research facilities for about 50 additional chemists.

FLOATED 'EM—When Socony-Vacuum Oil Company refinery workers at Augusta, Kan., had to move two huge tanks, they dug a canal, pumped in 4 million gallons of water and floated them to the new location. See item below.

Tanks Floated by Workers in Socony-Vacuum Kansas Project

Two 55,000-barrel storage tanks, each weighing about 200 tons, were converted into "ships" for a few hours by employes of Socony-Vacuum Oil Company, Inc., at its Augusta, Kan., refinery.

The engineering and the maintenance and construction departments had this problem: The tanks, each measuring 115 feet in diameter and 30 feet in height, had to be moved separately—one, 150 feet, the other, 450 feet. Eventually, they were to be joined by two others and all four were to be served by a common pumping and manifold system.

It was impractical to dismantle these six-ring units made of boiler plate five-eighths of an inch thick, and at 200 tons each they couldn't be skidded over land. So floating was decided upon.

A canal was constructed between the old and new sites by using an earth-fill dike. So that the tanks would settle in the right spots, five-foot vertical chalk lines were marked on the exact north and east sides of the containers. At the new locations metal bars were sunk at the north and east points of the compass, at distances equal to the vessels' radius. Bilge pumps were installed to handle possible leaks in the tanks.

To insure adequate depth for flotation, nearly 24 inches, about 4 million gallons was pumped from the Whitewater and Walnut Rivers into the canal. (See accompanying photo.)

Finally, two caterpillar tractors and two winch trucks, attached to the tanks by cables, started the vessels on their voyage. When the north and east lines on the tanks coincided with the north and east metal bars, and while the mobile equipment held the cables fast, the plug was pulled out of the canal, the water returned to the rivers and the tanks settled into their new locations.

The actual flotation took only three hours.

Sun Oil Company Prepares Site for New Ontario Plant

Sun Oil Company has started clearing a site on newly-acquired property for a 10,000- to 15,000-barrel-per-day refinery which it announced last year. Construction is scheduled to start soon and completion is expected in about 15 months.

Sun sold a 125-acre site originally acquired for its Sarnia refinery to Dow Chemical of Canada, Ltd., and at the same time purchased from Dow a 200-acre site immediately south of the present property. Dow and Sun said the transactions would provide both with greater room for future expansion. The property acquired by Dow is adjacent to its present Sarnia plant.

MSA Releases Figures On Oil Construction Costs Overseas

The Mutual Security Agency has released figures indicating that MSA and ECA have financed a total $250 million expansion of European and North African petroleum industry during the past four years. This is some 20 percent below the 1947 estimate of $309.4 million.

In comparison, Cornelius J. Dwyer, MSA petroleum branch chief said, the 1947 estimate called for a 282,000 barrels per day expansion whereas the actual capacity was increased by 764,000 barrels daily.

On the current expansion program, he pointed out, the estimate is approximately $170 million with MSA to finance $37 million of this, with some $17.7 million tagged for materials and equipment and about $19.3 million for U. S. "know-how."

Canadian Oil Starts Up New Fluid Cat Cracker At Sarnia

A fluid catalytic cracking unit at Canadian Oil Companies new 20,000-barrel-per-day refinery at Sarnia, Ontario, has gone on stream, and the entire refinery is scheduled to be in operation by early summer.

Petrochemical Plant to Be Constructed at New Orleans

American Cyanamid Company will build a plant near New Orleans, La., for the production of chemicals from natural gas. The new plant for which a certificate of necessity was recently issued by the government, will represent an investment of about $50 million and will be located on a 600-acre site in Jefferson Parish, La., about 10 miles above New Orleans on the west bank of the Mississippi river. The plant will produce ammonia, acetylene, hydrocyanic acid

How to keep a tank from boiling

LIGHTNIN Mixers blending gasoline in a large Texas refinery.

If you want all the capacity your tanks can deliver, equip them with LIGHTNIN Mixers.

Here are two typical examples of fast turnover at low cost, made possible by LIGHTNIN Mixers:

Operation	*Tank*	*Installed HP*	*Total Time*
Blending motor fuel	**110,000-Bbl.**	**75**	**65 minutes**
Blending lube oil	**10,000-Gal.**	**7½**	**20 minutes**

LIGHTNIN Mixers are fully guaranteed to do the job *right*. This unique guarantee is backed by nearly 20 years of service to refiners . . . and by a continuing research program that works constantly to give you the most advanced answers to fluid agitation problems.

LIGHTNIN Side Entering Mixers are supplied in gear drive and V-belt drive models for tanks of any size or shape. They are easily repacked from outside the tank, without draining the tank. Modifications are available to meet your service conditions. Write today, outlining your needs—or mail the coupon for descriptive bulletins on LIGHTNIN Mixers.

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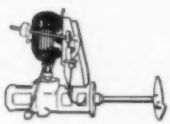
PORTABLE
⅛ to 3 HP



SIDE ENTERING
1 to 25 HP

TOP ENTERING
¼ to 500 HP

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- ☐ B-75 Portable Mixers (electric and air driven)
- ☐ B-101 Condensed Catalog showing complete line
- ☐ B-102 Top Entering Mixers (turbine and paddle type)
- ☐ DH-50 Laboratory Mixers

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More than thirty years of successful engineering and construction in all parts of the world has provided know-how that can be invaluable to you.

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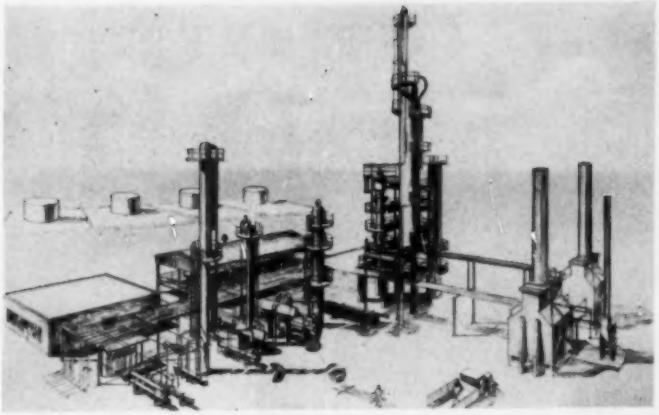

THE WORLD'S FIRST FLUID HYDROFORMER is pictured above in the artist's sketch made at Destrehan, La., where the 2000-barrel-per day unit will be located. Being built by The M. W. Kellogg Company for Pan-Am Southern Corporation, the main group of vessels in the center of the drawing is the reaction-regeneration section. The reactor is the largest vessel in the group. Atop it is the spent catalyst stripper. To the left of the reactor is the regenerator, while behind it stands the catalyst storage drum. The unit's other principal components (left to right) are as follows: Control house; compressor house; three recovery towers comprising main fractionator, absorber and stabilizer, the reaction-regeneration section; the naphtha furnace; the recycle gas furnace; and the blowback air heater.

and derivatives of these products, among them acrylonitrile and ammonium sulfate. The plant will consist mainly of outdoor type manufacturing process units with administration, maintenance, warehousing, employee services and control laboratories being housed in one or two story buildings.

Chemical Construction Corporation, a subsidiary of American Cyanamid Company, is the architect-engineer and construction manager of the plant. A construction sub-contract has been awarded to the J. A. Jones Construction Company of Charlotte, N. C. Various New Orleans contracts will participate in the building of the plant.

New Mexico Refinery Changes Hands, Expansion Scheduled

The Ute Oil & Refining Company has sold its 1000-barrel-per-day Graham, Texas, refinery to E. R. Marchman and is purchasing a 2500-barrel-per-day plant from Petroleum Products Refining Company at Prewitt, N. M. Marchman, of G and B Oil Company, formerly was part owner of the Graham plant when it was known as Gratex Refining Company.

C. A. Copple, vice president of Ute, said his company now will concentrate most of its sales efforts in the New Mexico area. The company expects to hike the Prewitt plant's capacity to approximately 10,000 barrels daily by about mid-October.

Esso Ponders Idea of New Refinery on Eastern Coast

Esso Standard Oil Company is weighing the idea of building a new refinery on the East Coast. Although a decision has not been made yet, the company has options on 800 acres of land near Norfolk, Va., and is to make soil-bearing and other tests to determine whether the property is suitable. The site is located on the Elizabeth river between West Norfolk, a suburb of Portsmouth, and the Navy's Craney Island installation.

Russian Coal-Hydrogenation Plant Under Construction

Reports leaking out from behind the Iron Curtain seem to indicate that Soviet Russia is building a large coal-hydrogenation plant near Lake Baikal in Siberia with completion expected to come sometime in 1953, some five years after construction was reported to have begun. The plant is expected to produce approximately 25,000 barrels per day of high-quality aviation gasoline from equipment consisting of some dismantled sections of the former German hydrogenation plant at Poelitz near Stettin and Blechhammer in Upper Silesia. Reports say the plant will employ the Poelitz unit for methane cracking over nickel contact with coal from deposits near Irkutsk being used for operation. According to reports, the Russians have not yet commercially operated coal-hydrogenation plants in the Soviet Union, but a Fischer-Tropsch plant has been placed on stream north of Lake Balkhash at Kazakstan.

Stan-Vac Boosts Capacity Of Proposed India Refinery

The capacity of the Bombay refinery planned by Standard-Vacuum Oil Company has been increased from the originally announced 19,000 to 25,000 barrels per day. The government of India has approved the expansion. The company said it now appears that the $35-million plant to be located on Trombay Island in Bombay Harbor, may be ready for operation several months sooner than the 1956 date first announced.

Seven New Tankers Ordered By Royal Dutch Shell Group

The Royal Dutch Shell Group has ordered seven oil tankers from Dutch shipyards totaling 121,000 tons. With the 15 tankers ordered in April of last year, this means that the Dutch shipyards have received total orders from the Royal Dutch Shell Group for 22 tankers with a total of about 400,000 tons.

New Sarnia Refinery Ships Initial Load Of Gasoline

The first gasoline produced at the Sarnia, Ontario, refinery of Canadian Oil Companies was shipped recently to a Sarnia service station 16 months from the time construction on the new plant got underway.

The fluid catalytic cracking unit began operating two weeks ago. Of the approximately 5000 barrels per day of feeder stock which the partially completed installations are running, about 60 percent is being processed into automotive gasoline, and the balance into fuel oil, propane and other products.

The refinery will process 20,000 barrels per day of crude oil when all units are completed and on stream. Other key units will come into production during the next few weeks. Formal opening for the new plant has been set for September 9.

Diamond Alkali To Proceed With Petrochemical Plant

The Diamond Alkali Corporation has announced it is going ahead with plans to construct facilities for production of vinyl chloride, polyvinyl chloride and perchlor ethylene from petroleum raw materials as part of a $10-million-dollar expansion program in Houston.

Shell Chemical Company, however, has abandoned joint plans for constructing these facilities with Diamond, and also has canceled its plans for ethyl chloride expansion. B. M. Downey, manager of Shell Chemical's Houston plant, said market conditions change very rapidly "in this fast stepping petrochemical industry" and what seems "like a bright idea today can develop a tarnished hue because of conditions over which one has no control." He said the company is now considering a "more attractive endeavor," but refused to elaborate on the statement.

Jefferson Plant Granted Certificate of Necessity

Jefferson Chemical Company, Inc., has announced that it has been granted a certificate of necessity for the construction of a new process unit at its Port Neches, Texas, plant. The new facilities will produce lubricating oil additives and other related products, and will be designed for batch or semi-continuous operation. Construction of the unit, which will be known as General Purpose Unit No. 2, is expected to begin during the third quarter of this year.

British Refinery Catalyst Plant in Full Production

The first plant designed exclusively for production of refining catalysts in Britain has gone into full scale production at Warrington under the ownership of Joseph Crosfield & Sons, Ltd. Production is expected to be 10,000 short tons yearly, enough to process 90,000 barrels of oil per day. Crosfield is using a Davison Chemical Corporation process.

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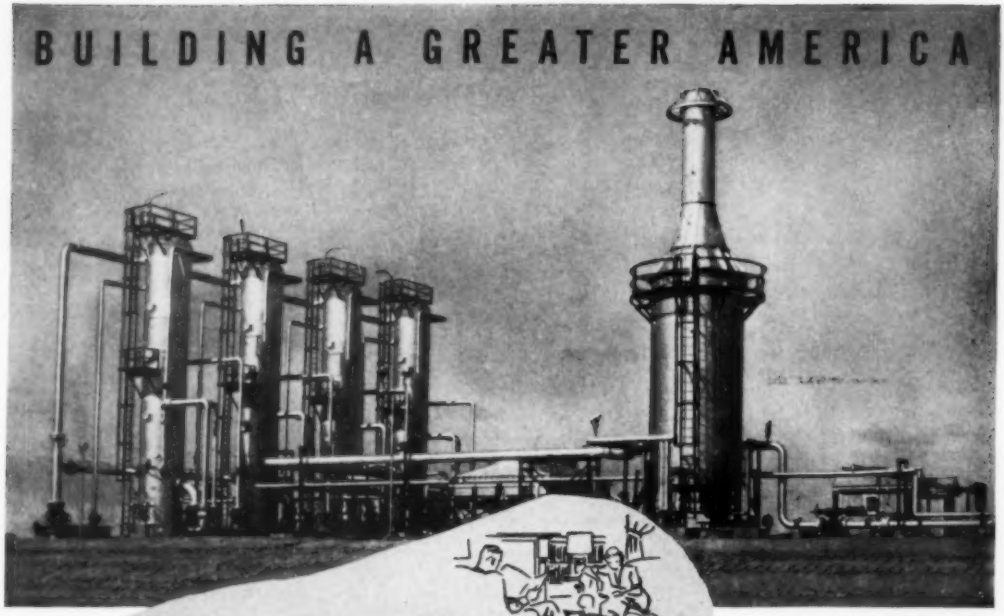

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Bench Scale Cracking Unit Reproduces Plant Conditions

C. W. RACKLEY and C. W. SHELLEY
Magnolia Petroleum Company, Beaumont, Texas

A SMALL fixed-bed cracking unit that closely reproduces large-scale pilot and commercial units has been developed and operated for several months in the Process Control Laboratories, Beaumont refinery, Magnolia Petroleum Company. This unit employs granular catalyst and is suitable for both research and plant control work. Catalysts and oils may be evaluated at practically all processing conditions except for internal recycle. The unit provides a rapid means of obtaining complete catalytic cracking yields at much lower investment and operating costs in comparison with large-scale equipment.

MICRO-METHODS of testing permit evaluations of cracked gasoline including octane rating,[1] vapor pressure[2] and boiling range by using only 500 ml. of total oil charge to the unit. The use of these micro tests increases the value of data obtained on the small scale unit.

The small scale unit is compact and can be easily operated over a wide range of temperature conditions, catalyst to oil ratios and space velocities. The entire unit including working area needs less than eighty square feet of floor space. With the exception of electricity, no other utility is required. Only eight man hours are necessary to perform a complete cracking run including testing of products for gravity, distillation and vapor pressure.

The principal pieces of equipment are a charge pump, oil preheater, reactor, condenser, synthetic crude receiver, gas holder and batch type synthetic crude oil still. The unit is operated at atmospheric pressure and without steam. A counter-balanced gas holder is used to recover all of the gas produced from cracking and distillation. Light hydrocarbon yields are obtained by mass-spectrometer analysis of the wet gas. The gasoline is analyzed by the Podbielniak Method. The synthetic crude oil is distilled on a batch unit that approximates the fractionation efficiency of commercial units. Fractions of gasoline, naphtha and gas oil are isolated whenever the study warrants. Accurate yields are secured by weighing all liquid products on an analytical balance. Carbon deposits on the catalyst are determined by an Orsat analysis of the combustion gases from burning a representative sample of the spent catalyst.

This unit reproduces both fixed bed and moving bed catalytic cracking conditions although it is of the fixed bed type. The desired catalyst to oil ratio and space velocity are obtained by the proper combination of charging rate, and volumes of catalyst and oil used.

TABLE 1

Comparison of Results Obtained on Bench Scale and Commercial Catalytic Cracking Units.

(Mid-Continent Gas Oil)

	Bench Unit	Commercial Unit
Dry Gas, Weight Percent C_3 and Lighter	5.2	5.0
Total C_4's, Volume Percent	10.9	11.6
C_4 Free Gasoline, Volume Percent (410° F. EP)	39.0	38.5
Cycle Stock, Volume Percent	50.3	51.2
Carbon, Weight Percent	1.7	2.1
Gas Oil Conversion, Volume Percent	49.7	48.8
C_4 Free Gasoline Octane (Res. + 3cc TEL)	96.5	96.4

Note: Above comparison is made at similar operating conditions using routine plant balance.

Performance

The yields obtained on the bench scale unit are in very close agreement with those obtained on commercial and large scale pilot units. Yields obtained on a Mid-Continent stock by both a commercial unit and the bench scale unit at similar operating conditions are shown in Table 1. Properties of the charge stock used in the experiment are shown in Table 2.

The reproducibility of the yields by the bench unit are excellent as shown by the data obtained by different operators and presented in Table 3. Bench unit data seem to be at least as accurate as those obtained on pilot units. This is shown by the information presented in Figure 1.

The small quantity of charge stock required for a run makes the bench unit particularly useful for evaluating the cracking characteristics of stocks that must be prepared in the laboratory. The example below refers to a study made of the effect of improved fractionation of a certain charge stock on catalytic cracking yields. The gas oil was distilled in the laboratory into fractions which were cracked separately. The results are shown in Table 4. A similar study conducted on large scale pilot or commercial equipment would be expensive and require a considerable amount of time without improving the value of the results.

Description of Apparatus

The unit is designed for cracking 500 ml. of oil at a catalyst to oil ratio of 4 volumes per volume, space velocity of 2 volumes per hour per volume and at temperatures between 800 and 1200° F. A simplified diagram and a photograph of the equipment are shown in Figures 2 and 3, respectively.

The reactor is a three-inch i.d. by 15-inch stainless steel vessel having a capacity of approximately two liters. A one-fourth-inch o.d. tube welded in a vertical position forms a thermowell in which six thermocouples are placed for indicating reactor temperatures.

TABLE 2

Properties of Mid-Continent Gas Oil Charged to Cracking Units.

(Cf. Table 1)

Gravity, °API	30.7
Aniline No., °F.	141.4
Acid Heat, °F.	6
Sulfur, Percent Weight	0.23
ASTM Pour, °F.	0
ASTM DISTILLATION:	
IBP, °F.	281
10 Percent	400
30 Percent	487
50 Percent	532
70 Percent	584
90 Percent	700
EP	748
Percent Recovered	95

TABLE 3

Reproducibility of Yields From Bench Catalytic Cracking Units.

OPERATORS	"A"	"B"
Average Reaction Temp., °F.	901	902
Yields:*		
Dry Gas, Weight Percent	6.1	5.8
Total C_4's, Volume Percent	9.9	10.2
C_4 Free Gasoline (410° F. EP), Volume Percent	32.4	32.3
Cycle Stock, Volume Percent	56.0	56.0
Carbon, Weight Percent	2.7	2.7
Octane, C_4 Free Gasoline (Res. + 3cc TEL)	97.6	97.4

* A mixed gas oil feed stock.

Standard one-half-inch nipples and band unions are attached to each end of the reactor forming a vapor proof connection at the top with an oil preheating furnace and at the bottom with a tube type condenser.

The reactor is suspended inside a cylindrical heater made by winding four 500-watt heating elements on a piece of standard four-inch iron pipe 18 inches in length. Each heater is controlled by an individual variable transformer mounted on the instrument panel which permits the temperature throughout the catalyst bed to be maintained at any desired level.

The unit has two charge tanks with a manifold at the pump intake for permitting either tank to be used. The start-up tank is used for circulating oil through a preheating furnace while bringing the unit to operating conditions. The regular charge tank is mounted on a balance. A contact point on the weight side of the balance activates a relay stopping the charge pump when a predetermined weight of oil has been charged to the unit. This contact point permits very accurate control of the oil charge by reducing the possibility of error inherent to manual control.

An adjustable stroke, piston-type pump, having a capacity of 70 ml. per minute is used for charging the oil.

Charge lines are wired with resistance heaters and insulated. These heaters and properly located infra-red heating lamps, permit the unit to be charged with high pour point stocks including wax.

The oil preheater is a quartz filled stainless steel vessel two inches i.d. by 21 inches long having one-fourth-inch pipe connections at the inlet and a one-half-inch tee welded to the outlet. It has a one-eighth-inch vertical thermowell having a thermocouple for indicating the furnace outlet temperature. The preheater is suspended inside a cylindrical heater. A 1400-watt heating element provides the necessary heat.

Two one-half-inch valves are attached to the tee at the outlet of the preheater. These valves permit operation of the oil charging system through the furnace and into the by-pass condensers until the exact cracking conditions are attained on the furnace and the reactor. Simultaneous switching of these valves permits diversion of the charge stock from the by-pass condenser to the cracking reactor at the moment desired.

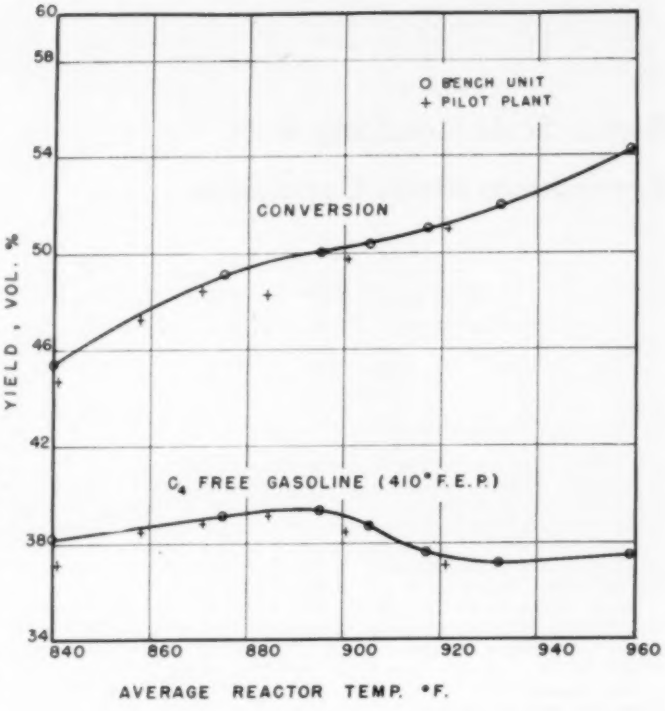

Figure 1. Comparison of Yields of Bench Unit with Pilot Plant.

At the outlet of the condenser a glass tee permits the recovery of the synthetic crude in a 500-ml. round bottom flask maintained at low temperatures in an iced bath. Uncondensed gases are disengaged from the synthetic crude in a one-half-inch by 14-inch straight glass condenser packed with one-thirty-second-inch stainless steel helices and cooled by the same circulating system as that used on the main synthetic crude condenser.

The disengaged gases are piped to a five cubic foot gas holder where they are combined with gases produced on distilling the synthetic crude. The gas holder is counter-balanced to operate at atmospheric pressure at all

TABLE 4

Effect of Improved Fractionation on Catalytic Cracking Yields of a Mid-Continent Gas Oil—Bench Scale Data at Constant Conditions.

FRACTION	Gas Oil	Gasoline Removed	Gasoline and Kerosine Removed	Kerosine Fraction	Gasoline Fraction
Percent Original Gas Oil	100	90.8	53.3	37.5	9.2
Yields:					
Dry Gas, Weight Percent	5.2	5.9	6.2	3.8	2.3
Total C_4's, Volume Percent	10.9	11.0	12.0	11.1	6.8
C_4 Free Gasoline (410° F. EP)	39.0	33.5	34.5	35.0	88.0
Cycle Stock, Volume Percent	50.3	55.1	53.8	54.2	3.3
Carbon, Weight Percent	1.7	2.0	2.6	1.4	1.5
Liquid Recovery, Volume Percent (C_4 and Heavier)	100.2	99.6	100.3	100.3	98.1
C_4 Free Gasoline Octane (Res. + 3cc TEL)	96.5	98.1	99.1	95.6	79.8

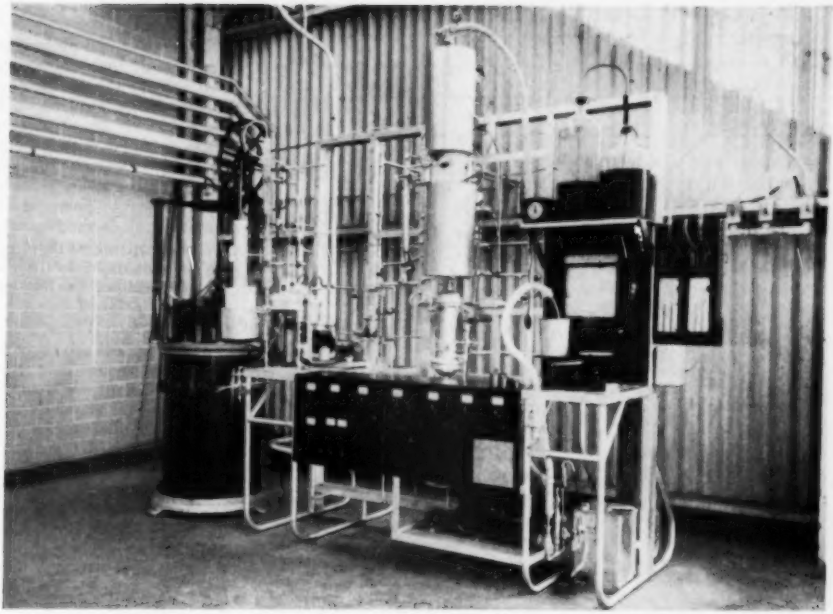

Figure 2. Characterized by its compactness, this small scale cracking unit can reproduce both fixed bed and moving bed catalytic cracking conditions.

levels and is calibrated within the accuracy of 0.0025 cubic foot.

The reactor is purged by a measured quantity of carbon dioxide which passes through the system into the gas holder.

The synthetic crude distillation unit consists of a 500-watt bell-type heater, insulated and mounted so as to permit easy dismounting; a five-eighth-inch by 14-inch glass column packed with glass three-thirty-seconds-inch diameter helices; a 30-760° F. ASTM distillation thermometer; a jacketed burette type receiver and a jacketed gas disengager mounted above the receiver. The condenser and gas disengager are operated at a temperature of 70° F. during the distillation of the synthetic crude oil. Non-condensable gases are piped into the main gas holder. The distillation column is wired with a resistance heater and insulated so as to permit making a 650-E.P. overhead product.

Operating Procedure for Plant Control Work

Before starting the unit the volumes of catalyst and oil to be charged are established. This is facilitated by the use of graphs similar to those shown in Figure 4,

Example:

Assume that the run should be done at

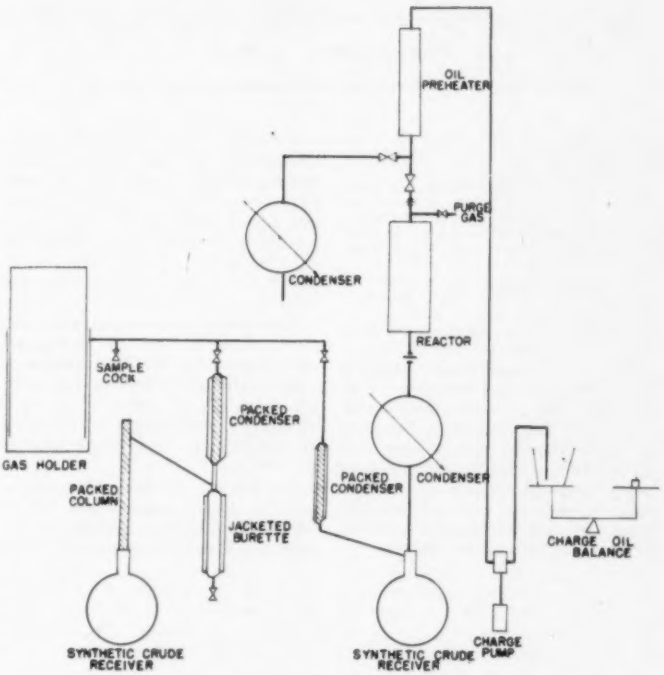

Figure 3. Bench Scale Catalytic Cracking Unit.

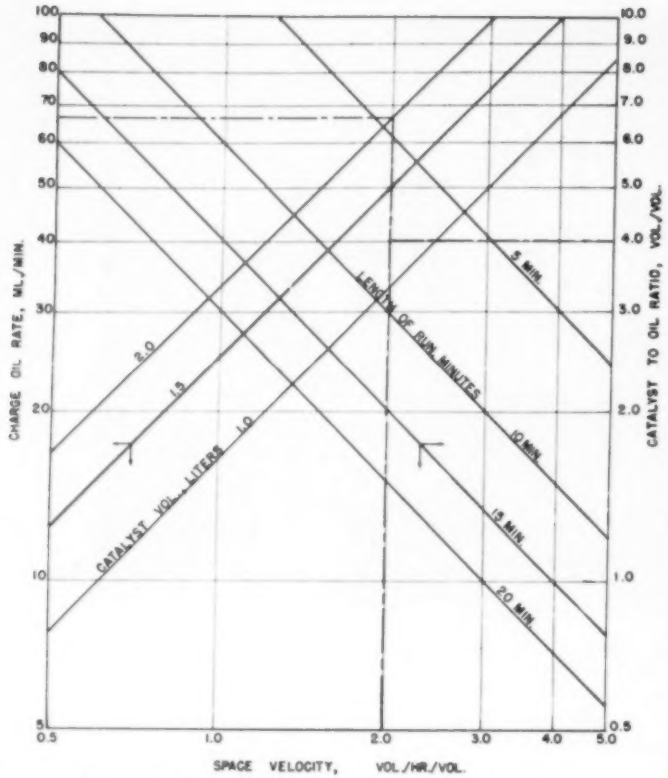

Figure 4. Chart for Determining Operating Conditions of Bench Scale Unit.

a space velocity of 2.0 volumes per hour per volume and a catalyst to oil ratio of 4.0 volumes per volume.

Draw a perpendicular line at 2.0 space velocity on Figure 4. Draw a horizontal line from 4.0 catalyst-oil ratio until it intersects the perpendicular line. The point of intersection shows that the cracking cycle is 7.5 minutes.

Two liters of catalyst may be used. For this quantity of catalyst and a 2.0 space velocity the charge rate is 66.5 ml. per minute. If 1.5 liters of catalyst are used, the charge rate would be 50 ml. per minute.

The catalyst used in the previous run is removed from the reactor and the catalyst under investigation charged to the unit. This is done by breaking the one-half-inch unions at each end of the reactor, swinging aside the condenser, which is mounted on a swivel, and removing the reactor from the heater. The catalyst removed from the unit is saved for carbon analysis.

The reactor is replaced in the heater, connections are tightened, thermocouples inserted in thermowells and the system checked for leaks with carbon dioxide at about 10 psig. Heat is applied to the reactor heaters and the charge furnace. The preheater outlet valves are arranged to by-pass the reactor.

The charge pump is started and the stroke adjusted to give the rate necessary to meet the calculated catalyst to oil ratio and space velocity. If the sample of oil to be evaluated is small, some other similar stock is substituted in bringing the unit to equilibrium conditions.

The reactor and gas collecting system are purged with carbon dioxide while the catalyst is brought to temperature. This removes moisture from the catalyst and purges the lines and gas holder.

The reactor and preheater are maintained at desired temperatures for at least 30 minutes before the cracking run is started. During this time the gas holder is set at zero, the purge bottle is filled with carbon dioxide, the iced synthetic crude receiver is placed at the main condenser outlet and the charge pump is switched to the feed tank on the balance.

A one kilogram weight is placed on the balance opposite the charge tank. When the level in the charge tank reaches a point of equal weights, the pump automatically stops.

The reactor block valve and by-pass valve are opened and closed simultaneously, and the pump and timer are started by removing the kilogram weight from the balance thus allowing the mercury switch to break contact.

The weight of oil to be charged is subtracted from one kilogram and that amount of weight is placed opposite the charge tank on the balance. A complete set of temperature readings is taken every two minutes during the cracking run and recorded on an operating log sheet.

When the required weight of oil has been charged the pump and timer stop automatically. This provides a very accurate measure of the quantity of oil charged and of the charging time.

At the end of the cracking cycle all heaters are cut off and the reactor is purged with carbon dioxide. About 15 minutes are usually sufficient for complete drainage of synthetic crude from the condenser. The line to the gas holder is closed and the synthetic crude receiver is removed from the cracking system and placed on the distillation column. During stabilization of the synthetic crude, the gases pass into the gas holder.

A record of all pertinent data for each run is kept on an operating log sheet which is used in yield calculations. Since most of the measurements are direct, the calculations are simple and the possibilities of error in obtaining final yields are very small.

ACKNOWLEDGEMENT

The writers would like to express their appreciation to J. W. Newton, W. W. Leach, and P. L. Smith for permission to publish this material.

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* * *

Progress Made in Design of Catalyst Activity Testing Units

Complete standardization sought on unit design, operating conditions, and expression of results of flexible high-precision apparatus

F. EMERSON IVEY, JR. and P. L. VELTMAN
The Davison Chemical Corporation, Baltimore

THE increasing use of catalytic cracking by the petroleum industry to satisfy the demand for high octane motor fuels has resulted in the need for more adequate facilities to evaluate the catalysts which are the heart of the processes. While numerous relatively satisfactory methods are now in use for evaluating catalytic activity and selectivity, the independent development of these test units by separate laboratories has created a situation in which it is extremely difficult, and in many cases impossible, to interpret the results from one method in terms of another. No standardization exists in either unit design, operating conditions, or expression of results. While this condition may not be especially troublesome to the individual refiner who is concerned primarily with his own data, it presents the catalyst manufacturer with a singularly difficult problem.

The catalyst testing equipment and procedure used by the catalyst supplier should possess characteristics which make it readily applicable in four different fields:

1) As a control over the catalyst manufacturing operation.

2) As a reliable criterion in the research necessary for the development of new or improved catalysts.

3) As a means of setting product specifications acceptable to and understood by the consumer.

4) As a tool for studying the usage of the product in commercial cracking plants.

It is apparent that while the first two of these criteria can be fulfilled by any one of several existing tests, in the ideal case items Nos. 3 and 4 can be fully met only by having test equipment sufficiently flexible to simulate the generally accepted methods. Although it is recognized that this latter aim is not wholly practical, it is also realized that the design of new activity testing facilities should incorporate such features that flexibility to test by several of the recognized methods is inherent.

Another mandatory characteristic of an acceptable activity test method must be its ability consistently to reproduce specific data on a selected standard catalyst with only small deviations. This quality can best be termed high precision. Such high precision is essential because of its intimate relation to confidence. It is apparent that a method which is proved to have poor precision can yield reliable data only if numerous repetitive analyses are made. Thus, time and expense are used as a counteractive against the inherent lack of precision. However, since catalyst activity testing is by nature a relatively lengthy and costly procedure, multiple analysis constitutes a most unsatisfactory substitute for high precision. Therefore, new testing equipment should be designed with precision as the basic element of all components.

This article describes the design and operation of activity testing facilities built to fulfill the requirements mentioned above. The final design is the result of extensive conversations with the petroleum technologists who use the various existing tests, study of the reported characteristics of these apparatus, and our own experience in the field. When the appropriate work has been completed, a subsequent article will present a detailed discussion of the unit characteristics when operating under the several conditions for which it was designed, as well as an investigation of pertinent operating variables.

Discussion of Original Equipment

From 1947 until the installation of the equipment to be described herein, Davison's catalyst activity testing was carried out by the Jersey procedure using apparatus which was a modification of that specified by Conn and Connolly.[1] Experience with this equipment led to the realization that much was to be desired from the standpoints of both flexibility and precision. In order that the development of the new equipment can be better understood, a brief review of this original unit will be helpful.

One hundred cubic centimeters of a pelletted catalyst was charged to a 1-inch i.d. stainless steel reactor tube whose upper section was filled with glass beads to act as the oil vaporizer and preheater. The reactor tube was supported in a block furnace whose average temperature was held at 890° F. Oil was charged with a reciprocating bellows pump to give a space velocity of 0.6 volume per hour per volume and a process period of two hours, and the liquid product was condensed in a graduate immersed in a +32° F. bath. Cracked gas passed through a dry ice-acetone condenser held at —40° F. and was measured with a dry-test gas meter. The liquid product was distilled in Engler equipment to a 400° F. end point using ASTM procedure D86-38. The spent catalyst was regenerated for further cracking cycles by transferring the entire reactor tube to a second furnace held at 1050° F. and passing an air-nitrogen mixture through the tube at such a rate that the regeneration was essentially isothermal. The carbon content of the spent catalyst could therefore be determined only after the last cracking cycle. This was done by grinding the pellets into powder with a mortar and pestle, then placing a one-gram sample in a combustion boat and inserting the boat in a horizontal tubular furnace (1-inch i.d.) held at 1200-1400° F. This furnace tube also contained a pelleted copper oxide catalyst to convert carbon monoxide to dioxide. Dry CO_2-free air was drawn through the tube and the CO_2 formed by combustion of the carbon was absorbed in Ascarite, the carbon being calculated from the increase in weight of the absorber.

It is generally recognized that the thermal and steam stabilities of a catalyst are of more concern than its activity as manufactured. Accordingly, it is standard practice in our laboratory to split each sample of fresh catalyst into two portions, one for thermal pretreatment, the second for steam deactivation. The thermal treatment is carried out in a battery of three muffle furnaces, the temperatures of which are 500° F., 1050° F. and 1550° F. Each muffle is purged with two liters per minute of air dried in a column of silica gel. This latter expedient is necessary to prevent simultaneous steam deactivation resulting from water desorbed from the catalyst. The sample is moved from the low temperature to the high temperature muf-

fle, remaining in each for three hours. Steam deactivitation is carried out in a block furnace with provisions for holding four tubes. Prior to being charged to the steaming tubes, the catalyst is first heated three hours at 500° F. and three hours at 1050° F. in the muffle furnaces. Again, the stepwise heating is practiced to eliminate adsorbed water under conditions such that deactivation therefrom will be a minimum. Steam deactivation is carried out at 1050° F. and 60 psig for 24 hours.

The over-all precision of this procedure and equipment was evaluated by the application of a careful sampling technique and rigorous statistical methods. A series of one quart samples were split from a 200-pound lot of catalyst selected as the standard sample. At weekly intervals, one quart was submitted to the laboratory under coding such that its identity as the standard would remain unknown to all except the quality control engineer supervising the program. The sample was split, the several parts deactivated as mentioned before, and the activities determined by two cycles on each. Data were accumulated, and the statistics for the D + L, conversion, gas, and carbon yields calculated by recognized statistical methods. Estimates of precision based upon 52 weekly submissions of the standard sample are shown in Table 1. These estimates include all the variability accumulated from the time that the sample was submitted to the laboratory: errors in pilling, activating, and testing for activity. It is quite apparent that the precision associated with these measurements is alarmingly poor, and it was the stimulus from this disclosure which led to a comprehensive study of all components of the test equipment and procedure and the subsequent design and installation of the equipment described hereinafter.

It might be mentioned that there was strong evidence at the time that if other test methods as then practiced were to be subject to this same impersonal scrutiny, the degree of precision would have been of the same magnitude. That is to say, our experience was more nearly typical than unusual.

TABLE 1
Precision of Original Modified Jersey Activity Test

	Level	Precision 2σ
After Thermal Pretreatment		
D+L: Vol. % Liquid Prod.	44.7	±3.56
Conversion: Wt. % Charge	51.3	±3.72
Gas: Wt. % Charge	9.0	±2.24
Carbon: Wt. % Charge	3.16	±1.08
After Steam Pretreatment		
D+L: Vol. % Liquid Prod.	26.6	±3.65
Conversion: Wt. % Charge	31.7	±4.72
Gas: Wt. % Charge	4.7	±1.10
Carbon: Wt. % Charge	1.06	±0.44

NOTES: Above statistics are based on 52 consecutive tests on standard catalyst samples. ± 2σ defines the limits within which 95 percent of the observations should lie. The values shown represent the precision estimated from the averages of two cycles per test.

"σ", the standard deviation, is calculated as:

$$\sqrt{\frac{\Sigma x^2 - \frac{(\Sigma x)^2}{N}}{N-1}}$$

where "x" is the attribute per test as the average of two cycles and "N" is the number of tests. "σ" is used here in the sense of the "estimate of the universe standard deviation."

In order to design new equipment of definite superiority, it is first necessary to appraise those details of the old which might be the cause of the inaccuracy or variability. Careful examination revealed the following characteristics which were felt to demand improvement:

1) Oil feed pump: Reciprocating action of the bellows caused a pulsating irregular delivery. Pumping rate was difficult to set and maintain.

2) Reactor tubes: The design led to undesirable liquid retention and difficulty in temperature measurement.

3) Steaming and cracking furnaces: Uneven heat distribution caused a 40° F. gradient in the catalyst bed.

4) Liquid product collection: Use of a graduated cylinder for volumetric measurement of the liquid product made it necessary to transfer the cracked oil to a separate stillpot, with resultant selective loss of light ends.

5) Gas collection: The dry test meters were both inaccurate and imprecise.

6) Carbon determination: The method involved grinding and mixing of pills containing varying amounts of carbon. The sample size constituted less than 1 percent of the total catalyst.

7) Distillation: ASTM procedure D86-38 claims a precision of only ±1 percent. This variation is quantitatively reflected in the resultant D + L.

8) Temperature measurement: Random iron-constantan thermocouples were found to vary as much as ±10° F. at 850° F. Chromel-alumel couples varied as much as ±25° F. at the same level and also showed a tendency toward drifting from calibration with time in service.

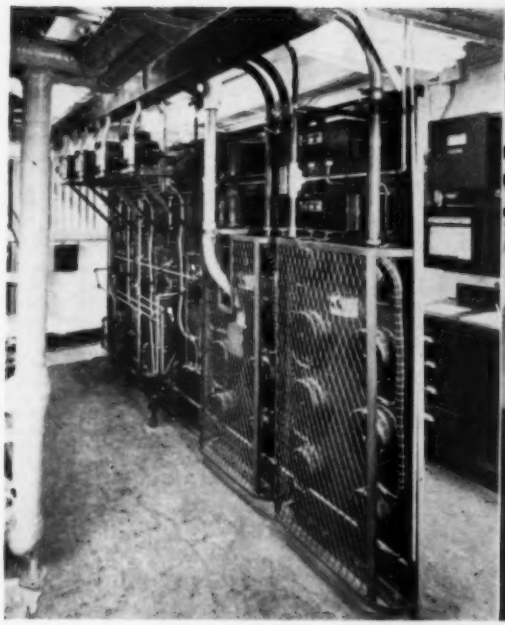
In addition to these major weaknesses, other minor details were found which required consideration: the mechanism and schedule for purging the reactor and stripping the catalyst after cracking, temperature control of product collectors and rigorous calculation of results, to name a few. Having thus clearly outlined the overall aims and specifically defined the weaknesses of the existing test equipment, it was possible to approach the design of new apparatus from a sound basis.

Design of New Equipment

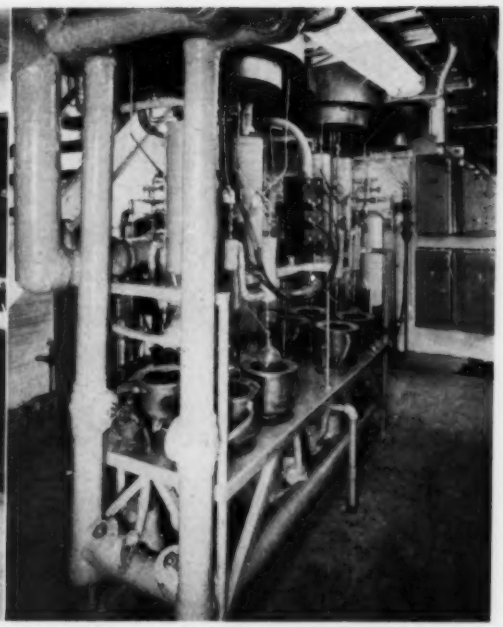
The data in Table 2 indicate the wide divergency in several of the existing generally accepted activity test methods. It is apparent that it is wholly impractical to attempt to design equipment flexible enough to simulate all of these methods, particularly the static bed methods as opposed to the fluidized fixed bed procedures. For several years Davison operated a Kellogg fluidized fixed bed unit, and determined that this unit lacked the necessary precision and was relatively insensitive to small real differences between catalysts. In addition, it was found impossible to test a full particle size range catalyst without scalping out fines. Conversations with the Kellogg people indicated that little improvement could be expected in this apparatus, and the corroborating experience of others has led us to turn away from the fluidized fixed bed technique for the present. This is not meant to be a condemnation of the basic philosophy of testing a catalyst in the fluidized state. Actually, it is believed that this is theoretically the ideal way in which to evaluate a fluid-type catalyst since it more nearly approaches that state in which it is ultimately used. However, there are indications that the problem of uniform fluidization of a full particle size range catalyst in small diameter reactors is not yet satisfactorily re-

TABLE 2
Methods for Determining Activity of Petroleum Cracking Catalysts

Method	Cat. State In Reactor	Quantity Tested	Process Period, Hours	Reactor Temp., °F.	Space Velocity	DISTILLATION Type	DISTILLATION End Point, °F.	Methods of Determining Activity
(1) Jersey	Static Bed, Pilled	200 cc.	2	850	0.6 V. H. V.	ASTM D-86-30	400	D+L: Volume Percent Liquid Product
(2) Houdry	Static Bed, Pilled	200 cc.	¼	800	1.5 V. H. V.	Special Microstill	410	Distillate: Volume Percent Charge
(3) Atlantic	Static Bed, Pilled	200 gm.	⅓	900	0.5 W. H. W.	Special Microstill	400	D+L: Volume Percent Liquid Product and Volume Percent Conversion
(4) Indiana	Static Bed, Powder	80 cc.	1	930	2.7 V. H. V.	Vigreux	410	Relative to a Fixed Standard Catalyst
(5) Texas	Fluidized Fixed Bed	400 gm.	½	920	2 W. H. W.	Packed Hempel	390	D+L: Volume Percent Liquid Product
(6) Kellogg	Fluidized Fixed Bed	710 gm.	2	850	0.6 W. H. W.	ASTM D86-40	400	D+L: Volume Percent Liquid Product



Photograph 1. Oil Feed Pump.



Photograph 2. Reaction Tubes.

solved. As a result, testing in the fluidized state has been rejected for the present. (Note: More recently it has been brought to the attention of the authors that a major oil company has developed a fluidized fixed bed test unit which shows great promise.) Concerning the four static bed tests, it was believed possible to design a single reaction system with sufficient flexibility to permit duplication of the various conditions required by each. Obviously, no single distillation system can be expected to fulfill the same functions as the four vastly different types specified by these methods, although it is probable that a column of the Vigreux type could be used successfully in conjunction with the Jersey and Houdry tests. The design of new equipment was approached from these premises.

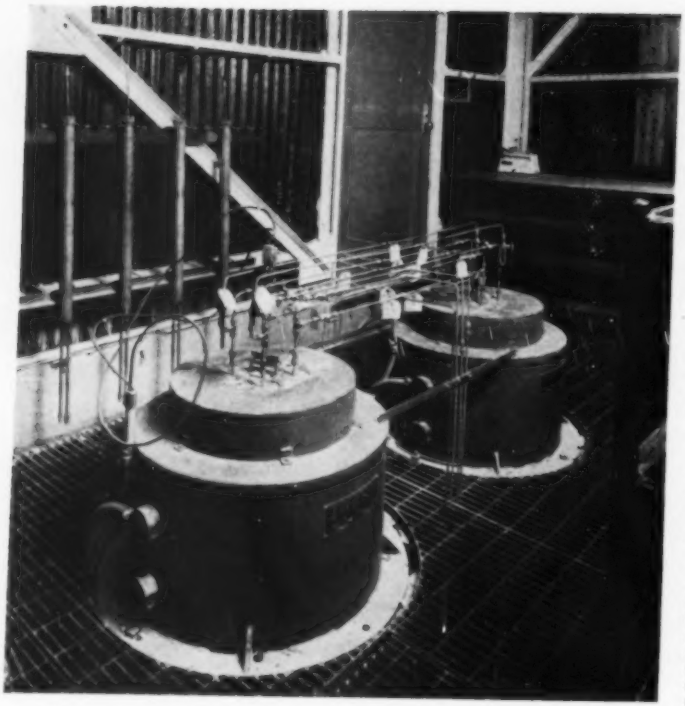
Another important requirement, heretofore unmentioned, was laboratory capacity. It was estimated that the catalyst activity testing requirement might at times exceed five samples per day on the basis of duplicate cycles on both thermally and steam deactivated portions of the samples. Therefore, the new laboratory facilities were designed to process eight samples per day (on three-shift operation) or a total of 32 cracking cycles. Using an average cycle time of six hours, this sample load would then require eight parallel testing units. However, rather than have eight completely independent units, it was found possible to reduce equipment cost by staggering the cracking operation on one sample with the regeneration operation on a second and thus permit all auxiliary equipment to serve two reactor tubes. This procedure will be discussed in detail later.

It was realized that the element of precision is largely dependent upon mechanical perfection in the component parts of the test equipment. Therefore, in the selection of the type and design of these components, emphasis was placed upon obtaining a minimum amount of mechanical variability while maintaining maximum sensitivity.

1) *Oil feed pump* (see Photograph 1). A survey of low rate constant volume pumps led to the conclusion that the single stroke positive displacement pumps of the type used in the Indiana test (Method 4) are far superior to other pumps for this service. The authors are indebted to Standard Oil Company (Indiana) for their helpful suggestions in this respect. The pump finally installed is driven by a synchronous motor through a gear train similar to an automotive transmission, permitting two speeds forward and one in reverse. In addition, the gears are interchangeable so that the fixed forward speeds can be varied with relative ease. The reverse gearing is set for rapid repositioning and filling of the pumps. Volumetric delivery is calibrated against the reading of a counter which records the number of revolutions of one of the two final bevel gears. The piston is a 1-inch diameter stainless steel bar ground to a 0.0001-inch tolerance. Calibration has shown that one count unit is equivalent to 0.25 ml. Direct gear drive assures constancy of delivery rate equal to the constancy of the frequency of the alternating current power supply.

2) *Reactor and steaming furnaces* (see Photographs 2 and 3). The center of each furnace is a temperature equalizer block of 90 percent copper, 10 percent aluminum alloy 12 inches in diameter and 33 inches long. Four two-inch diameter holes spaced at 90° on a 6½-inch diameter circle are bored through the length of the block to receive the reactor tubes. A one-half-inch diameter hole down the center provides space for the controlling and recording thermocouples. The body of the furnace, consisting of ribbon-type heating elements, refractory, insulation and shell, was designed and built to the major specification that the temperature gradient in the reactor tubes would approach zero degrees across the catalyst bed. The block sits freely inside the furnace, allowing a one-half-inch annular space between heating elements and block, and permitting ready removal of the block should repairs to the heaters be necessary.

The heating load is carried by four ribbon-type elements wound spirally along the block. A single 1.5-kw winding extends over the upper seven inches of the block and a similar winding surrounds the bottom seven inches. The middle 19 inches are wound with two 3-kw ribbons in parallel. Each of the four windings is serviced by a transformer, permitting manual balancing of the temperature gradient in the block. When the desired balance is obtained, a



Photograph 3. Steaming Furnaces.

controller regulates all four circuits at the pre-set temperature level. In addition to the controlling and recording thermocouples in the block and a pencil-type probe couple in each reactor tube, four thermocouples are spaced longitudinally in the annulus between the heating elements and furnace block. It is these four couples which are used to adjust the temperature gradient. Thus each furnace is serviced by ten thermocouples during operation with a full complement of tubes.

3) *Reactor tubes* (see Photograph 2). The reactor tubes are 26½-inch lengths of 1⅜-inch i.d. No. 347 stainless steel seamless tubing. The oil inlet line extends through the top cap permitting the oil to drop onto a 10-inch bed of quartz chips which serve as a vaporizer and preheater. The quartz rests on a 10-mesh stainless steel screen mounted approximately 12 inches from the top of the tube. A perforated, stainless steel disc supporting the catalyst is mounted three inches from the bottom of the tube. Thus, for a 200 cc. catalyst charge a two-inch disengaging space exists between preheater and the top of the catalyst bed. The bottom cap of the tube has a surface dished for complete drainage into the cracked product outlet. This bottom cap is also provided with a packing gland which permits a bare, pencil-type thermocouple to be introduced directly into the catalyst bed for temperature probing. Since the top of the reactor tube carries a flange which rests directly on the top of the furnace block, the geometry of the reactor tube locates the catalyst charge in the longitudinal center of the furnace.

4) *Liquid product collection* (see Photograph 3). Cracked products are first cooled by passage through a vertically mounted water-cooled condenser, and are then collected in a 500 ml. round bottom flask provided with a 24/40 standard taper female ground glass joint. During the distillation, this same flask serves as the stillpot so that it is never necessary to transfer liquid product from one flask to another. The stainless steel tubing connecting the water condenser with the product receiver carries the stainless steel male half of the 24/40 joint with the tubing extending through the joint and into the rounded portion of the flask. The annulus between tubing and ground steel joint is tapped by a second stainless steel tube to carry the cracked gases into the knock-back condenser. Thus, gases released by the liquid product pass from the flask without interfering with incoming liquid. The flask is immersed in a 32° F. constant temperature bath. The knock-back condenser is held at —40° F. so that the gas collected is essentially propane and lighter while the liquid product contains most of the C_4 and heavier. The temperatures of the liquid product baths and the knock-back condensers are held constant by circulation of a refrigerated glycol-water stream in the first case and a refrigerated alcohol-water stream in the second. The temperatures are automatically maintained by a central two zone refrigerating system. The temperature of the liquid product baths varies as little as ±2° F. at 32° F., while the variation of the knock-back condensers is less than ±5° F. at —40° F.

5) *Gas collection* (see Photograph 3—rear). The cracked gas is collected over water in a 12-inch diameter cylinder having a capacity of about 60 liters. A variable height water drain permits continual adjusting of the receiver pressure to one atmosphere, and a thermometer and a manometer in the gas space provide the necessary data for correcting the gas volume to standard conditions. The receiver is calibrated against the water level as read on a meter stick anchored to a vertically mounted tubular glass level gage. By calibration, one millimeter in height is equal to 75 ml. of gas at measured conditions.

6) *Regeneration and carbon determination.* The most common method for determining the carbon content of spent catalyst usually involves discharging the catalyst from the reactor, grinding the pellets to a powder if the catalyst has been tested in that form, mixing for homogeneity, and extracting a sample of one to two grams. The carbon content of this sample is then determined by combustion in a tubular furnace, collection of the products of combustion, and adsorption of the carbon dioxide in either a caustic solution or on ascorite. In the first case, the decrease in volume is measured and in the second case the increase in weight of the ascorite is the variate.

Several disadvantages in this technique were recognized: destruction of part of the test sample prohibiting further activity testing, and the uncertainty of the small combustion sample being representative of the total spent catalyst. This second point is of considerable concern, since in a fixed catalyst bed reaction system a carbon gradient exists from inlet to outlet. It was believed that the technique used in the Houdry Cat A (Method 2) offered a solution to these difficulties. Accordingly, facilities were incorporated for introducing air, nitrogen and oxygen to the reactors and for conveying the flue gas through a tubular furnace to a carbon dioxide adsorption system. In the furnace the gases are contacted with copper oxide and platinized silica gel catalysts at 1200-1400° F. to convert carbon monoxide to dioxide. The gas then passes through a liquid trap and a sulfuric acid scrubber (for water removal) to a caustic scrubber. The greater part of the carbon dioxide is absorbed in the caustic, but for protection of one-inch diameter tube containing alternate two-inch layers of moisture, CO_2 and moisture absorbents is used for absorbing the last trace of CO_2 and water. The caustic scrubber consists of a gas absorber of 350 ml. capacity with a 60 mm. D. extra-coarse fritted glass bottom. The myriad of fine bubbles thus has about nine inches of contact with liquid. The scrubber and safety tube are weighed as one unit on a torsion balance accurate to 0.1 gram with a 500 gram load. The carbon deposit is calculated from the increase in weight of this absorption system.

7) *Distillation of the liquid product.* A distillation column capable of making a reasonably clean separation with high precision in a practical length of time was deemed necessary. Since the precision of the ASTM distillation is claimed to be only ± one percent, this apparatus was considered to be unsatisfactory. The Vigreux column used in the "Indiana" test (Method 4) appeared to be capable of high precision, and contained the flexibility essential for varying operating conditions. Therefore, the Vigreux column was adopted as the basic element

in the distillation of the liquid product.

Several modifications of "Indiana's" accessory distillation equipment were made to improve the ease of operation and the degree of precision. A 600-watt heating mantle is used to heat the still-pot, and this has been found to have ample heating capacity to distill 200 cc. of liquid product in one-half to three-quarters of an hour. Since automatic circulating refrigeration was available, the dry ice-acetone knock-back condenser of the Indiana still was replaced by a tubular condenser through which the —40° F. ethanol-water coolant is circulated. The still head was modified by reducing the top lip to accommodate a 19/22 standard taper ground glass joint. A temperature controller was made so that the male element of the joint is included in the stem, and locates the center of the controller bulb opposite the vapor drawoff. The controller is adjustable over the range 380-420° F., and as in the "Indiana" equipment activates the power supply to the stillpot heater and to a solenoid valve which delivers an air blast to cool the inner jacket of the column.

8) *Temperature measurement and control.* Experience had indicated that when using iron-constantan thermocouples, the mere changing of thermocouples could cause a shift in measured temperature of over 10° F. Discussions with the thermocouple supplier developed that the iron-constantan thermocouples as normally marketed vary ± one percent in the 500-1500° F. range. This is equivalent to an error of ±9.0° F. at the typical cracking temperature level. The supplier further corroborated our experience with chromel-alumel couples which have an even greater variation between couples and also show a tendency to drift from calibration with time in service.

In order to reduce this large temperature measuring error, two steps were taken:

a) All thermocouples for use in the activity testing laboratory are first checked by the supplier in a thermocouple checking furnace against a standard platinum-rhodium couple. Only those which show less than ±½ percent error in reading are shipped, and they are tagged with the appropriate correction data so that the error is reduced to ±2° F.

b) When these couples are received, the same checking routine is followed using our own checking furnace and standard thermocouple. Thus every thermocouple used for catalyst activity testing work is doubly checked to insure temperature measurement accurate to ±2° F. It is the considered judgment of the men qualified in the field that this represents the best accuracy which can be obtained in practical routine operation.

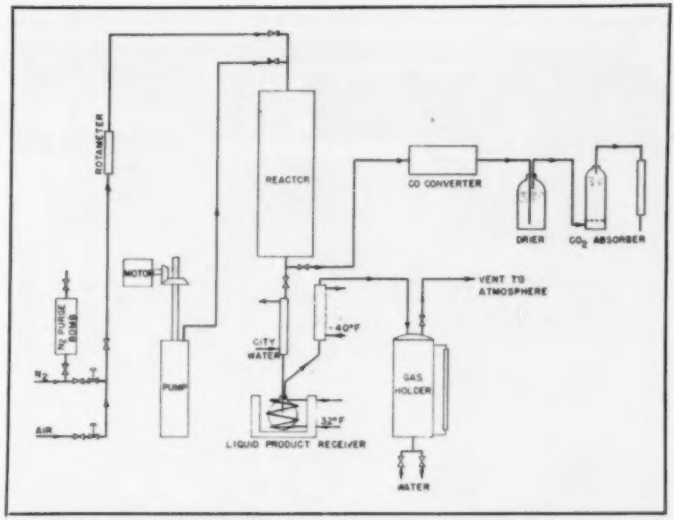


Figure 1. Simplified Flow Diagram, Catalyst Activity Units.

Control of the temperature of all furnaces is invested in proportioning input controllers. These instruments have the characteristic of adjusting the power input as a direct function of the extent of drift from the control point. It has been found in practice that the furnace block temperature plots as practically a straight line on a recorder chart which can be read to 1° F., i.e. there is minimum cycling of temperature due to the control instrument. A typical temperature survey on one of the two cracking furnaces is shown in Table 3. These data indicate that a negligible temperature gradient exists across the catalyst bed and that there is no temperature difference between the four tube positions.

Operating Procedure

A schematic flow diagram of a single reaction system is shown in Figure 1. The laboratory is equipped with four parallel systems of this type, but eight reaction tubes. Thus, while four samples are undergoing the cracking phase, four others are being regenerated. Proper scheduling of the operation, therefore, permits the simultaneous testing of eight catalyst samples. Three distillation columns assure that no bottleneck will exist at this point.

Obviously, catalyst can be charged either as pellets or powder. Should the powder form be used, a thin glass wool mat on the supporting screen suffices to retain the sample with minimum pressure drop. Since a temperature survey with the bare thermocouple probe in a loaded reactor tube has indicated only a two degree gradient throughout the catalyst bed, the bed height is flexible insofar as thermal conditions are concerned.

Prior to a cracking run, the reactor, liquid product receiver, knock-back condenser and gas transmission lines are purged with nitrogen. A rate of 1 liter per minute for 20 minutes is normally used, a rotameter serving as the metering device. Immediately after the cracking period, a similar purge is employed, and purge gas can be collected in the gas holder along with the cracked gas. While the rotameter is used to adjust the rate, the volume of this second purge is measured by the reduction in pressure of a calibrated prepressured bomb as in the "Indiana" method (see Photograph 4 for the size and location of these bombs).

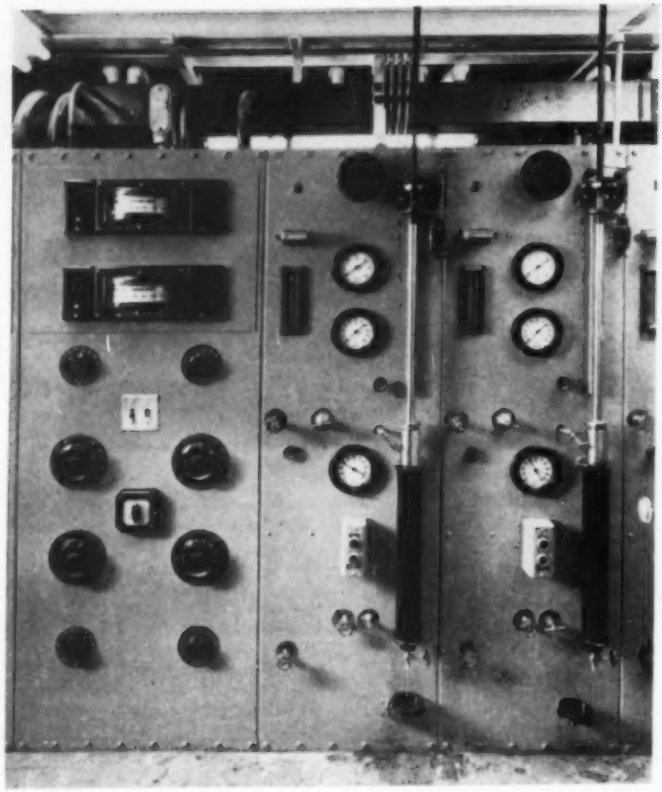
To fill the oil pump, a capillary tube at the bottom of the pump is immersed in a container of charge oil, and the pump piston is run upward from the

TABLE 3

Typical Temperature Survey of Cracking Furnace

General Location of Probe	Distance of Probe Below Preheater, Inches	Reactor Tube Probe Temperatures, °F.				Block Temperature, °F.
		1	2	3	4	
Bottom of Preheater	0	850	850	850	850	850
	1	850	850	850	850	850
Top of Catalyst	2	850	850	850	850	850
	3	850	850	851	851	850
	4	851	851	851	851	851
	5	851	851	851	851	851
	6	851	851	851	851	851
Center of Catalyst	7	851	851	851	851	851
	8	851	851	851	852	852
	9	850	850	850	851	851
	10	850	850	850	850	851
	11	850	849	849	850	850
Bottom of Catalyst	12	850	849	849	849	850
	13	849	847	848	848	850
	14	848	847	848	848	850
Bottom of Reactor	15	846	845	846	847	851

NOTE: All measurements made with specially selected and calibrated iron-constantan thermocouples.



Photograph 4. Calibrated Prepressured Bombs

position reached at the end of the previous run. During the filling operation, the oil line running from the pump to the inlet of the reactor tube is valved off at each end to keep it filled with oil. When the pump has been filled, the filling capillary is closed, a vent line at the pump outlet is opened, and the piston is started downward and allowed to continue until oil is discharged through the vent. At this point, the pump is turned off and all valves are set to start pumping into the reactor tube. This rather involved procedure was found necessary to guarantee that any air bubbles in the pump and pump discharge line are purged out. Since oil flow to the reactor starts immediately when the pump is turned on, a calibration of revolutions of the driving gear against volumetric displacement of the piston has been found to be sufficient to measure the oil charge, and no weighing in of the charge is necessary. Using this technique, the weight recovery for the cracking runs averages between 98 to 100 percent, indicating that the oil charge measurement must be reasonably accurate.

The regeneration technique has been found to be quite critical. It is desirable to maintain the instantaneous maximum bed temperature below 1050° F. to safeguard against thermal deactivation and fixing of the carbonaceous deposit. Therefore, regeneration is begun by passing a 4:1 nitrogen-air mixture over the catalyst at the rate of 0.5 liters per minute for 15 minutes. Oxygen partial pressure is then increased by using a 1:1 nitrogen-air mixture for 15 minutes at the rate of 0.3 liters per minute. Next, one liter per minute of air is introduced and this is continued for 30 minutes. The final two-hour period utilizes straight oxygen at one liter per minute. Visual examination of many catalysts after regeneration has shown that practically complete removal of carbon is accomplished. While most catalysts are not sufficiently temperature-sensitive to demand such careful step-wise increase in regenerating conditions, certain ones do demand cautious treatment.

As would be expected, the distillation operation is sensitive to the rate of distillation. Therefore, in running a distillation, a fixed heat input schedule is used, a low input to remove the light ends and a higher input for the main body of the distillation. To compensate for physical differences in the distillation columns themselves, the cut-point for each still is determined by multiple distillations of a standard hydrocarbon fraction whose gasoil content above 400° F. is accurately known. By such means the cut-points of the three stills were found to differ as much as 5° F.

Estimate of Precision

In order to evaluate the increase in precision accomplished through the improved equipment and operating procedure, it was necessary to have data of the same type as that already presented for evaluating the precision of the original test units. Since the old units were evaluated on the basis of the Jersey D + L test which uses pilled catalyst, the same test method was used to describe the precision and levels of the data from the new laboratory. Data were accumulated from weekly tests on the standard catalyst sample which was prepared and submitted to the laboratory according to the procedure already described. After approximately six months, the data were analyzed by accepted statistical methods to evaluate the level and precision of the important measurements. Summarized data

TABLE 4

Precision of New Activity Test Equipment Using Jersey D + L Method

	Average	PRECISION 2σ	PRECISION 3σ	Range
After Thermal Deactivation:				
D+L: Volume Percent Liquid Prod.	48.1	±3.16	±4.74	±3.35
Gas: Weight Percent Charge	6.20	±1.23	±1.85	±1.25
Carbon: Weight Percent Charge	3.00	±0.66	±0.99	±0.65
After Steam Deactivation:				
D+L: Volume Percent Liquid Prod.	26.0	±1.40	±2.10	±1.5
Gas: Weight Percent Charge	2.5	±0.42	±0.62	±0.45
Carbon: Weight Percent Charge	0.90	±0.28	±0.42	±0.50

NOTE: Above statistics are based on 27 consecutive tests on the standard catalyst sample. ± 2σ defines the limits within which 95 percent of the observation should lie. ± 3σ the limits within which 99.73 percent of the observations should fall. The values shown represent the precision estimated from the average of two cycles per test. The standard deviation, σ, bears the same connotation as in Table 1.

and statistics are shown in Table 4.

A comparison of the estimates of precision presented in Tables 1 and 4 indicates the degree of improvement which can be attributed to the new equipment and operating procedure. Based on the steam deactivated standard sample, the error in D + L measurement was reduced to about one-third of the old, the error in carbon measurement to about one-half, and the error in gas measurement to about one-third. The fact that the improvement in precision of the corresponding measurements on the thermally deactivated standard is not as great requires further explanation.

Since the estimates of precision include variability due to pilling, deactivating, cracking, and distilling; and since the same pilling, cracking, and distilling equipment is used randomly for evaluating both the thermal and steam deactivated portions of the sample, then it becomes apparent that only two sources of variability affect the "thermal" samples, but not the "steam" samples:

1) The muffle furnace used for thermal deactivation at 1550° F.
2) A greater inherent sensitivity of thermally deactivated catalyst.

Our experience with muffle furnaces leads us to conclude that the first of these two possible causes cannot be ignored. It has been observed that the simultaneous temperatures at various points within the muffle furnace can differ as much as 25° F. In addition, the action of the temperature control instrument causes an appreciable variation in temperature at any one spot since there is no large heat-storing reservoir such as the block in the cracking or steaming furnaces. Therefore, although the sensitivity of thermally deactivated catalyst may be a contributing factor, action is now being taken to investigate the value of a tubular thermal preheating furnace having characteristics comparable to the new cracking and steaming furnaces.

It should be made quite clear that the estimates of precision shown in Table 4 do not necessarily indicate the best possible performance of the test units. Inspection of the individual pieces of data will indicate why this is so. During the six months' interval encompassed by the data, certain changes were made in the mechanical equipment and/or operating procedure looking toward further improvement in the precision or accuracy of the measurements. These changes had the effect of causing small shifts in the level of the data, so that the over-all statistics average data from different universes. However, since the statistical data which describe the precision of the measurements from the original equipment include the same type of level shift originating from known causes, the statistics in Table 4 are presented on the same basis in order to describe without bias the improvement due to the new equipment and procedure alone.

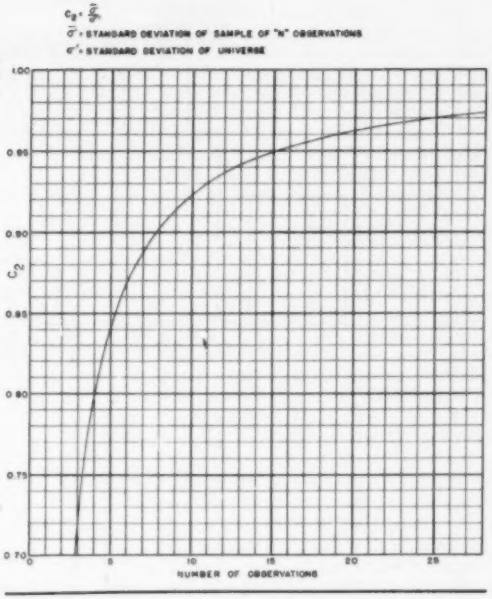


Figure 2. Effect of Sample Size on Confidence in the Standard Deviation.

To illustrate the effect of the inclusion of data from different universes in the over-all estimates of precision, let us analyze the statistical data from the D + L and carbon determinations on the thermally deactivated standard sample. In both cases, it is observed that the range of the data is much smaller than the three-sigma (99.73 percent) limits, and that in the case of the carbon data, the range is actually within the two-sigma limits. Since it is known that 27 observations are more than sufficient to establish accurately the standard deviation of a distribution (Figure 2 indicates the relation between the number of observations and the confidence which can be placed in the calculated standard deviation), then the fact that the respective ranges and standard deviations appear to be incompatible can have only two explanations:

1) The 27 observations are not sufficient to establish true range, and/or
2) The assumption that in these specific cases the distributions of variability follow the normal frequency function, which is the basis for the calculation of the standard deviation, is not true.

Only subsequent data can reveal to what extent the first condition is responsible. But the influence of the second possibility is subject to mathematical check.

Figure 3 presents histograms of the 27 observations on D + L and carbon. Superimposed upon the histograms are the normal frequency distribution curves calculated from the actual distributions under the assumption that the actual distributions are normal. Comparison of the histograms with the normalized distributions provides a criterion of the normalcy of the data. Such a comparison can be both visual and mathematical. By visual inspection the D + L data appear to be negatively skewed but not particularly kurtotic, while the carbon data appear to be positively skewed and normal in kurtosis. Using accepted statistical methods, β_1 and β_2 factors were calculated for both distributions. β_1 defines the degree of skewness; if it is above 0.4 or below —0.4 (the value for the normal curve is zero) the distribution is appreciably skewed. β_2 defines the amount of kurtosis (peakedness or flatness). If β_2 is less than 2.4, the distribution is less kurtotic (flatter with shorter tails) than the normal curve; if β_2 is greater than 3.8 the distribution is more kurtotic (more peaked with longer tails) than the normal curve. The value of the normal curve is 3.0. In the two cases under consideration, the factors were calculated to be:

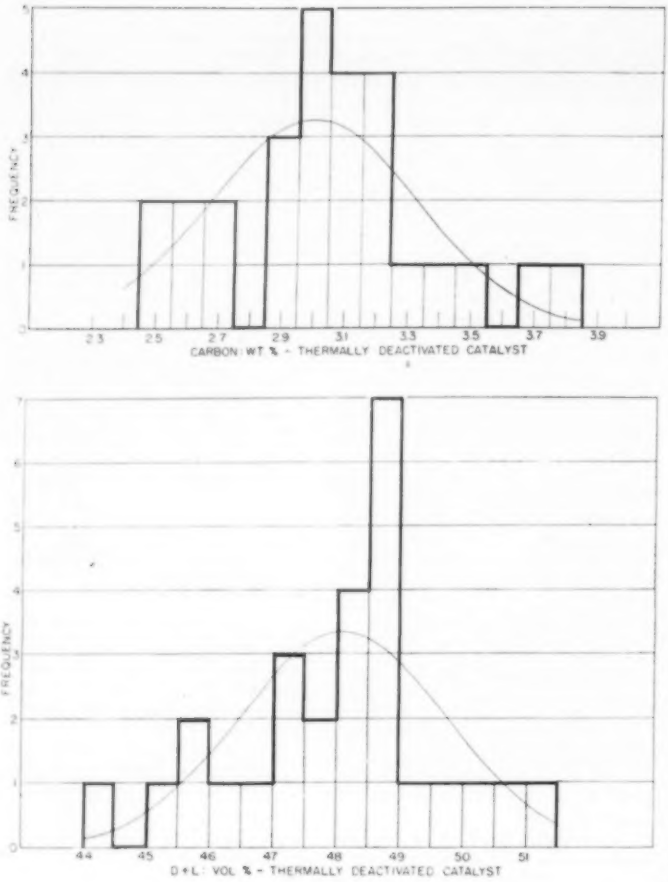


Figure 3. Typical Frequency Distributions vs. the Normal Curve

	D + L	Carbon
β_1	—0.28	0.32
β_2	2.66	2.89

Thus, both distributions are adjudged to be relatively normal as to both skewness and kurtosis, although the skewness picked out visually is present in a minor degree.

The obvious question, then, concerns whether the visual and mathematical criteria are contradictory. The answer is that they are not. The visual inspection of the distributions indicates truncated forms, a condition which will exist if data from different universes are included. The mathematical criteria state that these data from different universes are all part of one greater universe which will be normal, given sufficient time and a continuance of the existing "random" practice of creating causes for small shifts in level of measurements. However, should the operational practice be completely frozen, then it is to be expected that the standard deviation will be reduced and become consistent with the range.

The foregoing discussion of the method used in analyzing activity unit data gives only an indication of the great importance which must be placed on this element of catalyst activity study. For the proper analysis of the data from equipment is the very heart of understanding the equipment itself. Without rigorous, unbiased standards for evaluating performance, the best equipment can go for naught, or poorer equipment can erroneously be considered satisfactory.

Conclusions

Cracking catalyst activity testing equipment has been designed and built to accomplish improvement in precision and maximum flexibility in mode of operation. Initial investigation of the equipment has disclosed that high precision is inherent in all measurements insofar as the activity test equipment itself is concerned. However, the data indicate that improvement in the thermal pretreating equipment would probably be beneficial.

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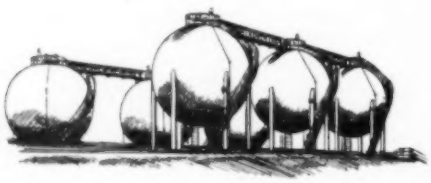

Evaluation of Radiant Heat Absorption Rates in Tubular Heaters

Part I. Radiation from Primary Sources

Graphical approach provides furnace designer with short but accurate method of solving the ordinarily laborious radiation equations

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THE primary and the major sources of radiant heat absorbed in most tubular heaters are the products of combustion of the fuel burned. The setting of the heaters (roof, floor, outside walls, bridge walls, etc.) also radiate to the tubes but do so only as intermediate reradiating surfaces which, theoretically at least, do not absorb heat by themselves but transmit to the tubes all heat received from the products of combustion.

The rates of radiant heat absorption by tube banks from combustion products are affected by four main factors: quantity of liberated heat; temperature of combustion, or "flame burst temperature"; amount of heat absorbing surface and "effectiveness" of the surface. The quantity of liberated heat is determined by the amount of fuel burned and the amount and temperature of air used for combustion. The flame burst temperature may vary from 4000° F., obtained when burning refinery gases with 20 percent excess air preheated to 460° F., down to 2300° F., when residual fuel oils are burned with 100 percent excess air

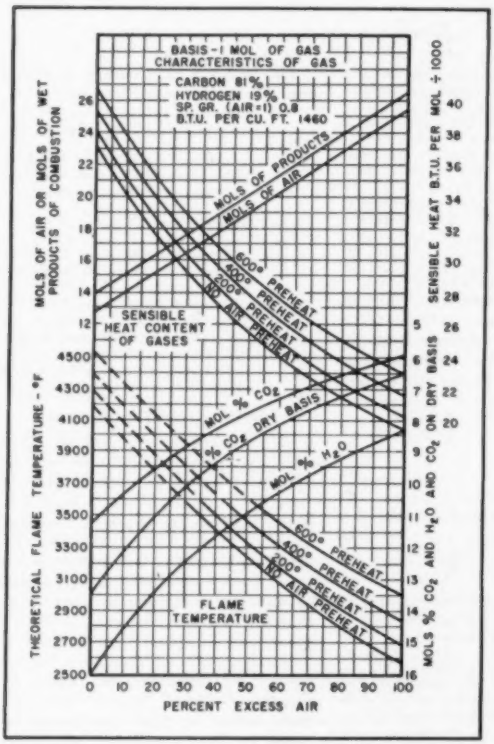

BASIS - 1 MOL OF GAS
CHARACTERISTICS OF GAS
CARBON 81%
HYDROGEN 19%
SP. GR. (AIR=1) 0.8
B.T.U. PER CU. FT. 1460
MOLS OF PRODUCTS
MOLS OF AIR
600° PREHEAT
400° PREHEAT
200° PREHEAT
NO AIR PREHEAT
SENSIBLE HEAT CONTENT OF GASES
MOL % CO2 DRY BASIS
MOL % H2O
FLAME TEMPERATURE
MOLS OF AIR OR MOLS OF WET PRODUCTS OF COMBUSTION
THEORETICAL FLAME TEMPERATURE - °F
SENSIBLE HEAT B.T.U. PER MOL ÷ 1000
MOLS % CO2 AND H2O ON DRY BASIS
PERCENT EXCESS AIR

Figure 1. Combustion Characteristics of Typical Refinery Gas Fuel.

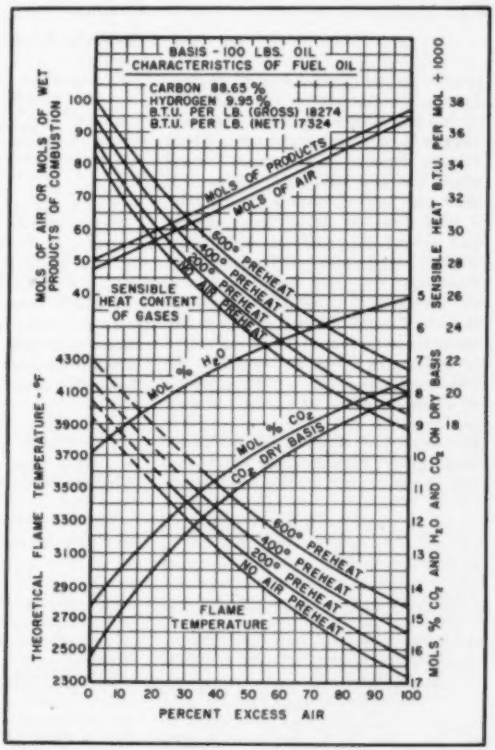

BASIS - 100 LBS. OIL
CHARACTERISTICS OF FUEL OIL
CARBON 88.65 %
HYDROGEN 9.95 %
B.T.U. PER LB. (GROSS) 18274
B.T.U. PER LB. (NET) 17324
MOLS OF PRODUCTS
MOLS OF AIR
600° PREHEAT
400° PREHEAT
200° PREHEAT
NO AIR PREHEAT
SENSIBLE HEAT CONTENT OF GASES
MOL % H2O
MOL % CO2 DRY BASIS
FLAME TEMPERATURE
MOLS OF AIR OR MOLS OF WET PRODUCTS OF COMBUSTION
THEORETICAL FLAME TEMPERATURE - °F
SENSIBLE HEAT B.T.U. PER MOL ÷ 1000
MOLS % CO2 AND H2O ON DRY BASIS
PERCENT EXCESS AIR

Figure 2. Combustion Characteristics of Typical Residual Fuel Oil.

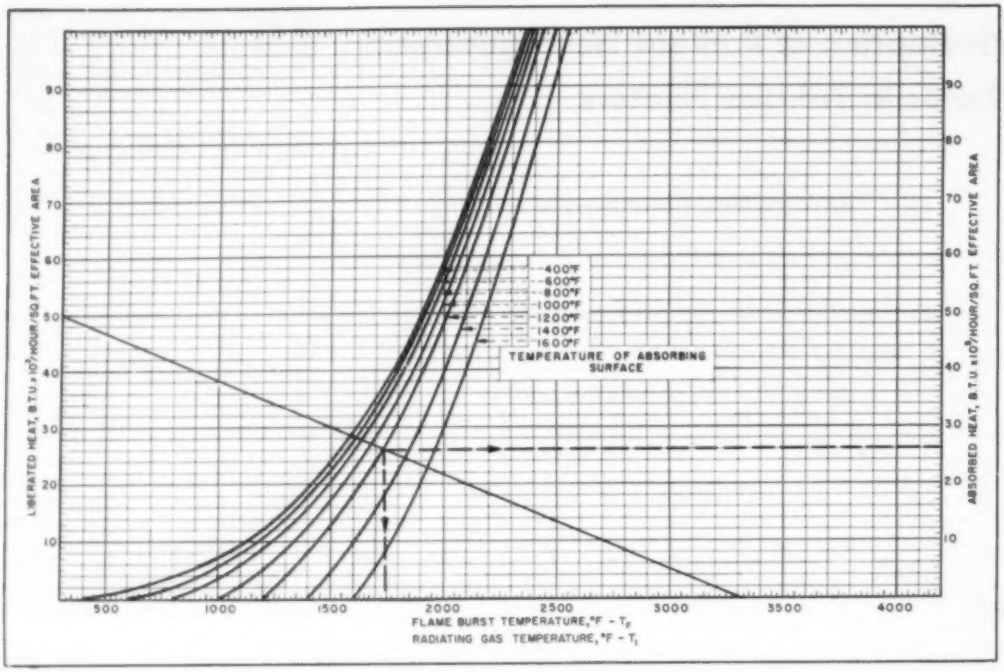


Figure 3. Graphs for Determination of Radiant Heat Absorption.

at 60° F. The effectiveness of the surface is determined by the emissivity of the heat absorbing surface and the "shape factor" of the tube bank, which in turn depends on the angle thruout which the heat absorbing surfaces of the bank "see" the source of radiation.

In evaluating radiant heat absorption by tubular surfaces from products of combustion two assumptions are made; first, that the surfaces and the products of combustion form two infinite parallel planes with the distance between planes small compared to their area; and, second, that the respective temperatures of the products of combustion and of the heat absorbing surfaces are uniform throughout the extent of these planes. Radiant heat transfer between these two planes can be determined by the equation:

$$Q_R = 0.173\,FA\left[\left(\frac{T_R}{100}\right)^4 - \left(\frac{T_T}{100}\right)^4\right] \quad (1)$$

Where

Q_R = radiant heat absorbed, Btu per hour

0.173 = Stefan-Boltzbann constant

T_R = temperature of the radiating surface, °R

T_T = temperature of the heat absorbing surface, °R

FA = "effective" heat absorbing surface, or the equivalent amount of perfect surface or "black body" which would absorb the same amount of heat as the actual heat absorbing surface. A black body is one which absorbs all of the radiant heat falling upon it without reflecting any heat to the surroundings. The effective surface is expressed by the product of the actual surface, A, and F, the relative emissivity of the surface. All actual surfaces are "grey" and F is always less than unity, taken as emissivity of a black body.

Radiant heat absorption calculations are usually made on the basis of one square foot of effective heat absorbing surface. This eliminates the factor FA and Equation (1) becomes

$$Q_R = 0.173\left[\left(\frac{T_R}{100}\right)^4 - \left(\frac{T_T}{100}\right)^4\right] \quad (2)$$

Where $Q_R = \frac{QR}{FA}$

The heat balance in the heater can be expressed by

$$Q_T = Q_L - Q_t \quad (3)$$

Where

Q_L = heat liberated by the amount of fuel burned per square foot of effective surface.

and

Q_t = residual heat in the products of combustion of this amount of fuel after they have given up the amount of absorbed heat, Q_R, by dropping from the flame burst temperature, T_F, to temperature T_R.

The heat lost by gases in dropping from T_F to temperature T_R is

$$WT_FCp_F - WT_RCp_r = WCp_a(T_F - T_R) \quad (4)$$

Where

W = pounds of products of combustion produced per square foot of effective heat absorbing surface

Cp_F = specific heat of gases at T_F

Cp_r = specific heat of gases at T_R

Cp_a = average specific heat of gases assumed constant through the temperature range. This assumption greatly simplifies the calculations and within the range of T_R encountered in most tubular heaters does not materially affect the actual values of radiant heat transfer.

Equilibrium Temperature

The theoretical temperature T_R at which the gases radiate to the heat absorbing surfaces is often called the "equilibrium" temperature because it is the temperature at which the gases absorb as much radiant heat from the nascent products of combustion at the flame burst temperature as they radiate to the heat absorbing surfaces. With the heater in equilibrium T_R is also the theoretical "residual" temperature or the temperature of the gases leaving the radiant section of the heater, T_t, because if T_t and T_R were not equal there would be heat interchange between T_t and T_R and the radiant section of the heater would not be in

equilibrium. The term T_i will, therefore, be used from now on for the temperature of the radiating gases. To avoid possible confusion with terms used in practice it must be noted here that T_i *is not* the so-called "bridge wall" temperature or the temperature of gases leaving the radiant section as measured by a thermocouple. T_i is the theoretical temperature determined by calculation which purposely neglect the effects of convection heat input from gases flowing over the bare refractories and the heat absorbing surfaces of the heater. In some types of heaters the difference between T_i and the measured temperature is quite large as will be shown later in the article.

By substituting the value of Q_t from (2) and the value of heat lost by the radiating gases from (4) into Equation (3) and using the symbol T_i for the temperature of the radiating gases the equation becomes

$$WCp_s (T_F - T_i) =$$

$$0.173\left[\left(\frac{T_i}{100}\right)^4 - \left(\frac{T_t}{100}\right)^4\right] \qquad (5)$$

In this equation T_F can be determined from the *net* calorific value of the fuel and the amount and temperature of the air used. Figures 1 and 2 give the combustion characteristics of a typical refinery gas fuel and residual fuel oil. The flame burst temperature of gaseous and liquid fuel does not change materially with wide changes in composition or calorific value but is affected mainly by the amount and temperature of the air used for combustion. The values of flame burst temperature obtained from Figures 2 and 3 can be used for any liquid or gaseous fuel burned in a refinery with a degree of accuracy sufficient for calculations of radiant heat transfer in tubular heaters.

T_t can be closely approximated from the temperature of the fluid being heated. In most petroleum refining heaters operating with average heat input rates of 10,000-15,000 Btu per hour per square foot of circumferential surface, T_t is 30-80° F. above the fluid temperature, with 50° F. as a good average. T_i is therefore the only unknown in the equation.

Graphical Determination

Equation (5) is rather cumbersome to solve mathematically because T_i is in the fourth power on the right hand side, but T_i can be easily determined graphically. The right side of the equation is plotted as a curve of values of radiant heat absorption for a given T_t with different values of T_i. The left side of the equation is a straight line with fixed terminal points. When $T_i = T_F$ the right side of the equation is zero and no radiant heat is absorbed by the surface. At this point the straight line has zero ordinate and an abcissa equal to the flame burst temperature T_F. When $T_i = 0$ the right side is equal to WCp_sT_F, or the heat absorbed by radiation is equal to the liberated heat. This point on the straight line has the amount of liberated heat as ordinate and zero as abcissa. The solution for T_i in Equation 5 is the point where the straight line intersects the curve.

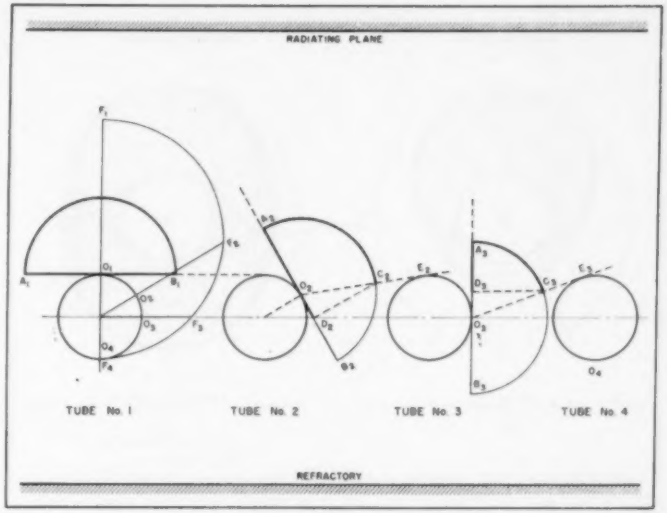


Figure 4. Graphical Determination of Flux Intensity Around Circumference of Tubes in Single Row Banks.

Figure 3 shows a group of curves for determining radiant heat absorption by surfaces at various temperatures. An over-all emissivity of 0.95 was used to obtain the values. At the equilibrium temperature T_i the gases radiate to the heat absorbing surfaces all of the heat they receive from the nascent products of combustion. Therefore, when the gases at this temperature radiate to a plane which is large in comparison with the distance between the plane and the boundary surface of the gas body, and which can absorb all of the incident radiant heat, the gases will behave as a black body and have an emissivity of 1.00. However there is a small heat loss by conduction through the refractories to the outside, and the gases, though assumed stationary and therefore supplying no convection to the heat absorbing surface, lose some heat by conduction through the film of gas in contact with the tubes. In most commercial heaters, an emissivity of 0.95 instead of unity will take care of these losses. For convenience the ordinate is marked "liberated heat" on the left side and "absorbed heat" on the right side, and the abcissa is given in °F. instead of °R.

Equation (5) is solved by drawing a straight line between the value of liberated heat on the ordinate and flame burst temperature on the abcissa. The intersection of the straight line with the curve for the desired surface temperature gives radiant heat absorption on the right hand ordinate and the equilibrium temperature of the gases, T_i, on the abcissa. The example shows the solution of Equation (5) for radiant heat absorption by a surface at 1200° F. when the liberated heat is 50,000 Btu per hour per square foot of effective surface and the flame burst temperature is 3300° F. Under these conditions the radiant heat absorption, Q_t, is 26,000 Btu per hour per square foot of effective surface and the equilibrium temperature, T_i is 1740° F.

The values of T_t obtained from Figure 3 are for a black body receiving radiation from an infinite parallel plane. Before these values can be used for tube banks the actual surface of the tubes in the banks must be converted by an appropriate shape factor to an equivalent black body surface.

When a tube in a bank is subjected to radiation from a plane parallel to the bank different portions of the tube circumference see the radiating plane through different angles and therefore receive radiation from the plane at different rates. The effect of angle of incidence or radiant heat absorption is given by Lambert's equation.

$$Q_a = Q_n \cos \phi \qquad (6)$$

Where

Q_a = radiant heat absorbed by the

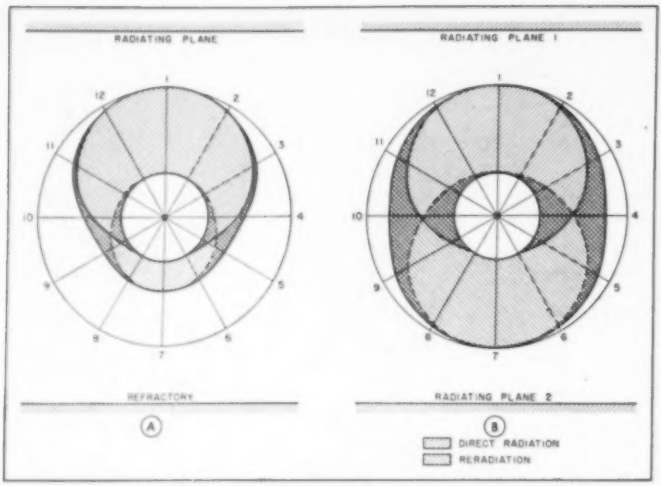


Figure 5. Flux Distribution around Circumference of Tubes in Single Row Banks. A—Primary Radiating Plane from One Side,—Refractory from the Other. B—Primary Radiation Both Sides.

surface in a given direction
Q_n = radiation normal to the surface
ϕ = angle between direction of radiation and the normal to the surface, or angle of incidence.

The maximum rate of heat absorption, taken as unity, is on the half of the circumference facing the radiating plane ("exposed" half), at a point on the diameter normal to the plane. The rate decreases clockwise and counter clockwise from this point until it is zero at some point near the opposite end of this diameter on the other ("shielded") half of the tube circumference. The location of the points of zero absorption depends on how much the tube is "shaded" by the adjoining tubes which in turn is determined by the ratio of the spacing to the diameter of the tubes. The summation of the relative rates, or flux intensity, around the circumference of the tube gives the fraction of available radiation absorbed by the tube, or the effectiveness of the tube surface.

Tube Banks and Flux Distribution

The effectiveness of tube banks and flux distribution around the circumference of tubes in tube banks is best determined graphically. In using the graphical method it is necessary to assume that radiation to the tubes follows the mechanism of radiation from an infinite plane to a "grey" body. It is also necessary to neglect the effect of variation in temperature of the tube surfaces and of the refractories upon the flux intensity and distribution around the circumference of the tube. In most commercial tubular heaters these assumptions do not materially affect the shape of the flux diagram or the absolute values of the flux intensity.

The method consists in determining graphically the included angle of incidence of radiant heat to a number of points around the circumference of the tube, and projecting the arc of this angle upon the tangent to the point in question to allow for the cosine relationship of radiant heat intensity. Radiant heat flux around the tube is symmetrical about the diameter of the tube normal to the radiating plane. Therefore, it is necessary to determine the flux distribution around only one half of the circumference of the tube as bisected by this diameter. The other half of the flux diagram is obtained by similarity.

The total radiant heat absorbed by a single row of tubes backed by a refractory wall, non-conducting to the outside, consists of two components—direct radiation from the radiating plane and reradiation by the refractory wall behind the tubes of that portion of direct radiation which passed through the tubes to the refractory wall. Direct radiation is determined first by method shown on Figure 4.

A few tubes are drawn accurately to scale as to outside diameter and tube spacing. The highest intensity of direct radiant heat is applied to point O_1 of the tubes, as shown on Tube No. 1. Radiation to this point is unobstructed by any other point on the tube or by the adjacent tubes. The included angle of incidence at this point is 180 degrees and the flux intensity is unity. Graphically the flux line at O_1 is equal to the length of diameter of 180-degree arc A_1B_1, drawn with an arbitrary radius O_1A_1 on a tangent to O_1. The length of the diameter is taken as unity and is drawn as line O_1F_1 on the flux diagram around Tube No. 1.

Point O_4 is completely shielded from direct radiant heat and the flux intensity at this point is zero. The method of graphical determination of flux intensity on points intermediate between O_1 and O_4 is shown for point O_2 on Tube No. 2 and point O_3 on Tube No. 3. Point O_2 is partially shielded from the radiating plane by its own circumference and by the adjoining tube. The included angle of radiation falling upon O_2 is the angle $A_2O_2C_2$ as determined by the intersection of tangent A_2O_2 to the tube and tangent O_2E_2 from O_2 to the adjoining tube. The projection A_2D_2 of arc A_2C_2 upon diameter A_2B_2, which is made equal to diameter A_1B_1 used for point O_1, represents the flux intensity at O_2 and is shown as line O_2F_2 on the flux diagram around Tube No. 1. The flux intensity on O_3 as shown on Tube No. 3 is similarly determined by the angle $A_3O_3E_3$ formed by tangent A_3O_3 to Tube No. 3 at O_3 and tangent A_3O_3 from O_3 to the adjoining Tube No. 4. The flux intensity at this point is equal to the projection A_3D_3 of arc A_3C_3 upon diameter A_3B_3 and is shown as line O_3F_3 on the flux diagram on Tube No. 1.

Reradiation Determined

The portion of available heat not absorbed by direct radiation passes through the bank to the refractory behind the bank. The refractory acts upon the tube bank as an opposite radiating plane which reradiates to the tube bank with an intensity $Q_r = 1 - Q_d$ where Q_d is the portion of the total available radiation which is absorbed by direct radiation. The reradiation superimposed on the various points of the tube circumference is determined by multiplying by the value of Q_r the flux intensity of direct radiation to the corresponding points of the tube circumference.

Figure 5A shows the flux distribution around the circumference of a tube in a single row bank with tube spaced on two diameters and Column 1 of Table 1 gives numerical values of the relative flux intensity on 12 points of the circumference. Total direct radiation to the tubes is 0.658 of the available. The fraction not absorbed by direct radiation is 0.342. The values of flux intensity by reradiation at the various points is obtained by multiplying 0.342 by value of direct radiation at the corresponding point such as at Point 1 for Point 7, at Point 2 for Points 6 and 8 etc. The average intensity of reradiation on all

points of circumference of the tube is 0.143 and the total reradiation is 0.225 of the available radiant heat. The total radiant heat absorption by a tube bank in a single row of tubes by the direct radiation and reradiation is 0.658 + 0.225=0.883 of the available radiation to the projected plane of the bank, or the effectiveness of the bank is 88.3 percent of a black body.

Column 2 of Table 1 and Figure 5B show the results of graphical determination of flux distribution around tubes in a single row bank irradiated from both sides by primary radiating planes of equal intensity. In this case the flux intensity around the tube is symmetrical not only about line 1-7, as is the case with the tubes on Figure 5A, but also along the line 4-10. Points 3 and 11 receive not only the same radiation from Radiating Plane 1, but bear the same relationship toward Radiating Plane 2 as points 9 and 5 do to Radiating Plane 1. For a given maximum flux intensity at point 1 the total radiant heat absorption by a single row of tubes subject to direct radiation from both sides is approximately 20 percent greater than that of a single row of tubes subject to direct radiation from one side and reradiation from a refractory from the other side.

Flux Distribution Around Tubes

Figure 6 shows the method of graphical determination of flux distribution around tubes in a two-row bank receiving direct radiation from a radiating plane and reradiation from a refractory. The flux intensity by direct radiation to the tubes in the first, or exposed, row of the bank is determined by the same procedure as used in Figure 4. The included angle of radiation to any point on a tube in the shielded row is determined by tangents from this point to the tubes in the exposed row between which the shielded tube receives direct radiation.

As shown on tube No. 5, point O_1 receives only that portion of direct radiation which can pass between tubes No. 1 and No. 2. The included angle of radiation to this point is determined by the tangents from O_1 to tubes No. 1 and No. 2. The length of the flux line at O_1 is projection N_1T_1 of arc H_1K_1. On the other hand, point O, as shown on Tube No. 4, receives radiation which passes between tubes No. 1 and No. 2, and between tubes No. 2 and No. 3. The total included angle of radiation to this point is the sum of angles FOE and DOC. The total length of the flux line at this point is the sum of projections of arc HK and of arc AG.

Flux intensity due to reradiation is determined by similarity. The refractory surface acts in the same manner upon the tubes in the shielded row as the radiating plane does on the exposed row, but at a different intensity. For example on Figure 5A, Point 7 on a tube in the shielded row corresponds to Point 1 on a tube in the exposed row and Points 5 and 9 on a tube in the shielded row correspond to Points 3 and 11, respectively, on a tube in the exposed row, etc. As shown in Column 1 of Table 2, 0.658 + 0.196=0.854 of the available radiant heat is absorbed by direct radiation to both rows. Heat available for reradiation is 1.0 — 0.854=0.146 and this factor is used to determine the intensity of reradiation from the refractory to the corresponding points on the tubes in each row.

Column 1, Table 2 and Figure 7A shows the flux distribution around the exposed and shielded tubes on a two row bank subjected to direct radiation from one side and reradiation from a refractory on the other side. Column 2 of Table 2 and Figure 7B shows the flux distribution around tubes in a double row bank exposed to direct radiation from both sides by primary sources of equal intensity. The flux distribution around only one tube in one of the rows is shown on the figure and in the tabulation, because the flux

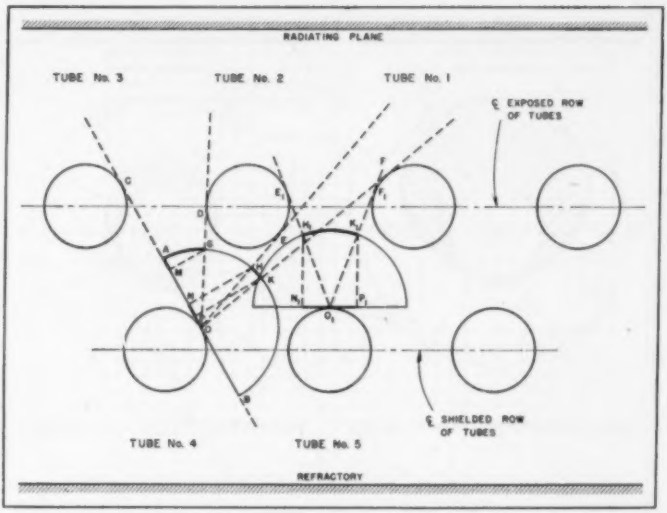


Figure 6. Graphical Determination of Flux Intensity Around Circumference of Tubes in Double Row Banks.

TABLE 1

Effectiveness of single row tube banks.

POINT No.	I Radiating plane on one side; refractory on the other side; tube spacing at 2 diameters.			II Radiating planes on both sides; tube spacing on 2.6 diameters.		
	Direct	Rerad.	Total	Direct from Plane 1	Direct from Plane 2	Total
1	1.000	0	1.000	1.000	0	1.000
2	0.918	0	0.918	0.920	0.004	0.924
3	0.676	0.027	0.703	0.694	0.118	0.812
4	0.336	0.115	0.451	0.376	0.376	0.752
5	0.080	0.232	0.312	0.118	0.694	0.812
6	0	0.315	0.315	0.004	0.920	0.924
7	0	0.342	0.342	0	1.000	1.000
8	0	0.315	0.315	0.004	0.920	0.924
9	0.080	0.232	0.312	0.118	0.694	0.812
10	0.336	0.115	0.451	0.376	0.376	0.752
11	0.676	0.027	0.703	0.694	0.118	0.812
12	0.918	0	0.918	0.920	0.004	0.924
Total	5.020	1.720	6.740	5.224	5.224	10.448
Average	0.419	0.143	0.562	0.435	0.435	0.870

Direct radiation = $\frac{0.419\ \pi D}{2D}$ = 0.658

Reradiation = $\frac{0.143\ \pi D}{2D}$ = 0.225

Total effectiveness = 0.883

Direct radiation from Plane 1 = $\frac{0.435\ \pi D}{2.6D}$ = 0.526

Direct radiation from Plane 2 = $\frac{0.435\ \pi D}{2.6D}$ = 0.526

Total effectiveness = 1.052

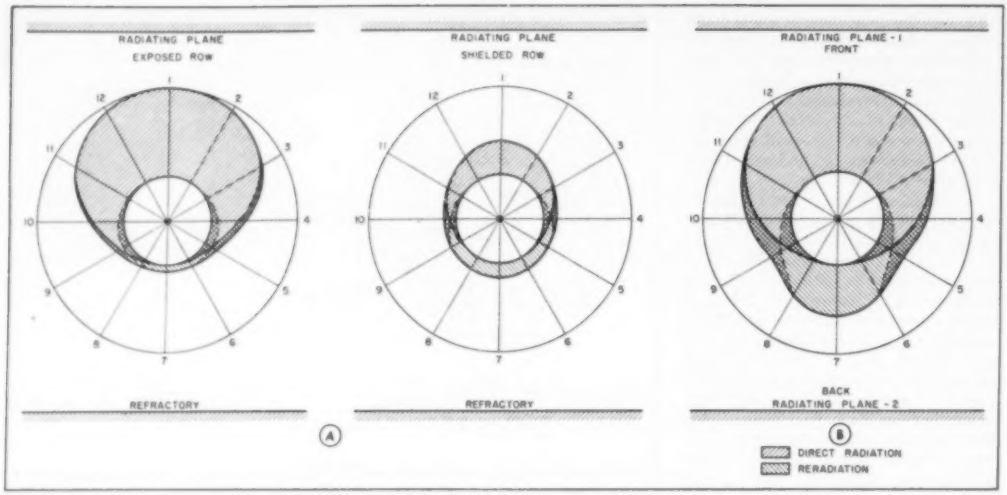


Figure 7. Flux Distribution Around Circumference of Tubes in Double Row Banks. A—Primary Radiation from One Side, Refractory from the Other. B—Primary Radiation from Both Sides.

distribution around a tube in the other row is a "mirror image" of the flux of the tube in the first row. With the same maximum flux intensity at Point 1 on the circumference of the tubes, a two row bank of tubes irradiated from both sides by primary radiating planes will absorb approximately 50 percent more radiation than a two-row bank receiving direct radiation from one plane and reradiation from a refractory.

Figure 8 shows the values of effectiveness of tube banks with one and two rows of tubes receiving primary radiation from a radiating plane on one side and reradiation from a refractory on the other. The effectiveness is expressed as a fraction of absorption by a black body with the ratio of center to center spacing to tube diameter as the variable. Effectiveness does not vary with tube diameter if this ratio is maintained. A bank with four-inch o.d. tubes on eight-inch centers will have the same effectiveness as a bank of five-inch o.d. tubes in ten-inch centers arranged in similar manner. Conversely four-inch o.d. tubes on ten-inch centers, has the same effectiveness as three-inch tubes on 7.5-inch centers or five-inch tubes on 12.5-inch centers.

Decreasing Difference in Radiant Heat Absorption

In most heaters the ratio of tube spacing to tube diameter is between 1.75 and 2.25 for single-row banks and from 1.75 to 2.75 for banks with two rows. The wider spacing with two-row banks is used to decrease the difference in radiant heat absorption by the first and the second row. For example, with two-row banks and tubes spaced on two-diameters the relative effectiveness of the first and second row is approximately 0.68 and 0.29 respectively, or in a ratio of 2.34:1. With a spacing of 2.75 diameters the relative effectiveness of the first row is approximately 0.57 and of the second row 0.37 or in a ratio of 1.54:1. There is a slight loss in over-all effectiveness of a two-row bank with wider spacing, from 0.98 to 0.94 in the above example.

Figure 8 can be used to obtain the effectiveness of tube banks irradiated from both sides, as shown in the following example. Find effectiveness of tube bank with two staggered rows of four-inch o.d. tubes on 10.5-inch center, irradiated from both sides. Ratio of spacing to diameter is 2.63. Effectiveness of front, or exposed, face of tubes (direct radiation to first row, from curve D) = 0.526; effectiveness

TABLE 2
Effectiveness of double row tube banks, staggered.

	I Radiating plane on one side, refractory wall on the other; equilateral tube spacing on two diameters.						II Radiating plane on both sides; tube spacing in each row on 2.6 diameters; distance between rows 2 diameters.		
	Exposed Row			Shielded Row					
POINT No.	Direct	Rerad.	Total	Direct	Rerad.	Total	Direct to Front	Direct to Back	Total to One Row
1	1.000	0	1.000	0.370	0	0.370	1.000	0	1.000
2	0.918	0	0.918	0.306	0	0.306	0.920	0	0.920
3	0.676	0	0.678	0.168	0.012	0.180	0.694	0.040	0.734
4	0.336	0.011	0.347	0.076	0.049	0.125	0.376	0.092	0.468
5	0.080	0.025	0.105	0.014	0.099	0.113	0.118	0.224	0.342
6	0	0.045	0.045	0	0.134	0.134	0.004	0.438	0.442
7	0	0.054	0.054	0	0.146	0.146	0	0.560	0.560
8	0	0.045	0.045	0	0.134	0.134	0.004	0.438	0.442
9	0.080	0.025	0.105	0.014	0.099	0.113	0.118	0.224	0.342
10	0.336	0.011	0.347	0.076	0.049	0.125	0.376	0.092	0.468
11	0.676	0.002	0.678	0.168	0.012	0.180	0.694	0.040	0.734
12	0.918	0	0.918	0.306	0	0.306	0.920	0	0.920
Total	5.020	0.220	5.240	1.498	0.734	2.232	5.224	2.148	7.372
Average	0.419	0.018	0.437	0.125	0.061	0.186	0.435	0.179	0.614

Direct radiation, exposed row = $\frac{0.419\pi D}{2D} = 0.658$

Reradiation, exposed row = $\frac{0.018\pi D}{2D} = 0.028$

Direct radiation, shielded row = $\frac{0.125\pi D}{2D} = 0.196$

Reradiation, exposed row = $\frac{0.061\pi D}{2D} = 0.095$

Total effectiveness, exposed row = 0.686

Total effectiveness, shielded row = 0.291

Total effectiveness, both rows = 0.977

Direct radiation, front = $\frac{0.435\pi D}{2.6D} = 0.526$

Direct radiation, back = $\frac{0.179\pi D}{2.6D} = 0.217$

Total effectiveness each row = 0.743

Total effectiveness both rows = 1.486

of back, or shielded, face (direct radiation to second row, from curve F) $=0.217$; effectiveness one row $0.526 + 0.217 = 0.743$; effectiveness of both rows $0.743 \times 2 = 1.486$.

The flux distribution around tubes and the effectiveness of tube banks as shown in the preceding tables and figures apply not only to tube banks arranged in planes in rectangular heaters, for which they were derived, but also to banks in circular heaters when the diameter of the heater is more than 12 times the diameter of the tubes. In applying the curves of Figure 8 to circular heaters the periphery of the cylindrical gas body which is the primary radiating surface, the surface formed by the center lines of the tubes and the surface of the reradiating refractory of the walls behind the tubes are assumed to be concentric cylinders with large diameters compared to distance between them. As the diameter of the heater is increased the difference in surface of the three cylinders becomes less significant so that they can be assumed to be equal.

The emissivity factor for infinite parallel planes is

$$F_{p1} = \frac{1}{\frac{1}{p_1} + \frac{1}{p_2} - 1} \qquad (7)$$

where p_1 and p_2 are the respective emissivities of the radiating and heat absorbing surface. For concentric infinite cylinders the emissivity factor is:

$$F_{cy} = \frac{1}{\frac{1}{p_1} + \frac{A_1}{A_2}\left(\frac{1}{p_2} - 1\right)} \qquad (8)$$

where p_1 and A_1 are the emissivity and surface of the inside cylinder and p_2 and A_2 of the emissivity and surface of the outside cylinder.

With A_1 approaching A_2, $\frac{A_1}{A_2}$ approaches unity and the emissivity between the cylinders becomes equal to the emissivity between two parallel planes.

End of Part I. Part II will appear in an early issue.

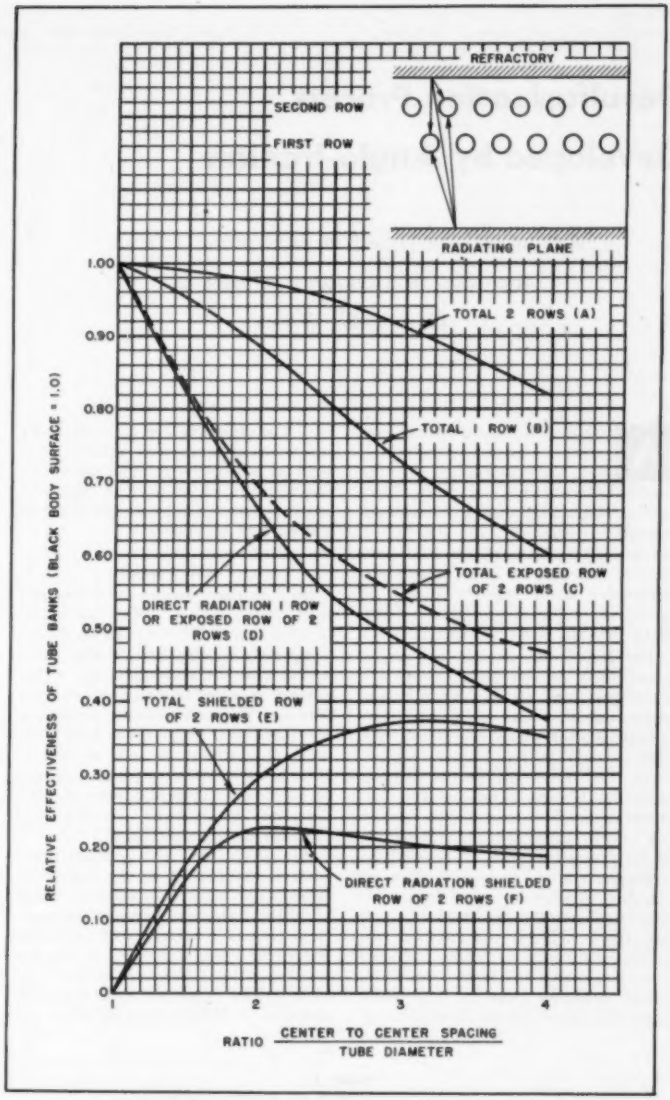


Figure 8. Effectiveness of Tube Banks in Single and Double Rows.

* * *

Desulfurization Process Developed by Anglo-Iranian

"Autofining", perfected in pilot plant, now in operation at Llandarcy refinery in New South Wales

A NEW catalytic desulfurization process, named Autofining" has been developed by the Anglo-Iranian Oil Company. This process has been fully proved in extended operations in a 350-barrel-per-day pilot plant and the first commercial size unit of 3500 barrels-per-stream-day input capacity is now in operation at the Anglo-Iranian Llandarcy refinery in South Wales.

The Autofining process operates at pressures of 50-200 pound gauge and at temperatures of 700°-800° F. and makes use of a very stable sulfur resistant catalyst which has a long life. The catalyst is regenerated periodically, the on-stream period varying with the boiling range of the feed stock. A small amount of gas, consisting mainly of hydrogen, is produced in the process and this is recycled. No hydrogen manufacturing facilities are required. A wide variety of feed stocks can be effectively desulfurized, ranging from natural and straight run gasolines through naphthas and kerosines to gas oils and light diesel fuels. Sulfur removed from the feed stocks is largely converted into hydrogen sulfide. The products are of good color and odor and are very stable. They need no subsequent refining treatment. The yields of liquid products obtained are 99 percent plus by weight or about 100 percent by volume.

Feed Stocks

Straight-run gasoline and naphtha feed stocks having ASTM end points of up to about 400° F. can be almost completely desulfurized by this process, and, at the same time, the octane number is raised by two or three numbers and the lead response considerably improved. With these feed stock catalyst on-stream periods of 800 to 1000 hours between regenerations can be employed. Typical results on Middle East straight-run gasoline and naphtha are given in Table 1.

Kerosines are also almost completely desulfurized by the Autofining process and catalyst on-stream periods of about 400 hours between regenerations are easily achieved. Of particular value for certain markets is the improvement in burning properties (i. e., char value) obtained. Pilot plant results on a Middle East kerosine are given in Table 2.

Straight-run light gas oils (i. e., high speed diesel fuels) may also be desulfurized. The degree of sulfur removal is lower than with lighter distillates but in the case of Middle East crudes, gas oils of 0.75 to 1.0 percent sulfur content can be desulfurized to the extent of 60 to 70 percent with catalyst on-stream periods of 200 hours. Typical results are reproduced in Table 3.

Processing Long Distillates

In some refinery situations it may be more desirable to desulfurize a long distillate and fractionate after processing rather than desulfurize separate products after fractionation. Results obtained when processing long distillates from Middle East and Slaughter (West Texas) crudes in this manner are given in Table 4.

Other materials which may be satisfactorily desulfurized by the Autofining process include the highly aromatic extracts obtained by the solvent

TABLE 1

Autofining of Middle East Straight Run Gasoline and Naphtha

	Straight-Run Gasoline		Naphtha	
Yield Percent Weight on Feed	99.5		99.7	
Sulphur Removal Percent	99.1		98.4	
Catalyst On-Stream Period, Hours	800		400	
	Feed	Product	Feed	Product
Specific Gravity, 60° F.	0.6957	0.6995	0.7800	0.7788
Gravity, °API	71.9	70.8	49.9	50.2
Distillation:				
I.B.P. °F.	81	78	298	284
5 Percent Volume at °F.	104	102	308	303
10 Percent Volume at °F.	116	112	312	307
50 Percent Volume at °F.	200	200	332	329
90 Percent Volume at °F.	269	270	369	369
End Point, °F.	299	300	403	408
Sulphur, Percent	0.081	0.0007	0.116	0.0019
Octane Number (Motor)	60.0	62.3	.....	.....
Octane Number + 1.5 ml. TEL/IG.	69.0	75.0	.....	.....
Octane Number + 3.5 ml. TEL/IG.	75.0	81.0	.....	.....
Color, Saybolt	ca.20	30+	ca.20	+26
Doctor Test	Positive	Negative	Positive	Negative
Corrosion Test	Positive	Negative	Positive	Negative

TABLE 2

Autofining of Middle East Kerosine

Yield of Prod % Wt.	99.5	
Sulphur Removal %	98.0	
Catalyst on-stream Period, Hours	400	
	Feed	**Product**
Specific Gravity, 60° F.	0.7985	0.7981
Gravity, °A.P.I.	45.7	45.8
Distillation:		
I.B.P., °F.	336	329
2 Percent Volume at °F.	352	345
10 Percent Volume at °F.	365	363
50 Percent Volume at °F.	404	404
90 Percent Volume at °F.	446	448
End Point, °F.	471	476
Sulphur Percent	0.180	0.004
Mercaptan Sulphur Percent	0.016	0.001
Color, Saybolt	+15	+17
Flash Point, °F.	126	106
Odor	Poor	Good
Doctor Test	Positive	Negative
Smoke Point, mm.	25	26
Burning Test (Institute of Petroleum):		
Consumption g/hour	20.6	20.1
Char Value mg/Kg.	28	14
Appearance of Glass	Gray-brown film	Very Faint gray film

TABLE 3

Autofining of Middle East Virgin Gas Oils

Yield of Product % Wt.	99.1	
Sulphur Removal, %	70.0	
Catalyst on-stream period, hours	210	
	Feed	**Product**
Specific Gravity, 60° F.	0.854	0.849
Gravity, °A.P.I.	34.2	35.2
Distillation:		
I.B.P., °F.	459	248
10 Percent Vol. at °F.	520	505
50 Percent Vol. at °F.	561	556
90 Percent Vol. at °F.	619	612
End Point, °F.	662	662
Sulphur, Percent	1.00	0.30
Diesel Index	55	55
Aniline Point, °F.	160	160
Carbon Residue (10 percent bottoms), Percent	0.11	0.11

The above inspection data refer to the total liquid product which contains a very small quantity of light ends. Removal of these light ends is easily accomplished in a simple flashing operation to give a product meeting specification flash point requirements.

TABLE 4

Autofining of Long Distillates from Middle East and Slaughter (West Texas) Crude Oils

Distillate From	Middle East Crude		Slaughter Crude	
Cut on Crude T.B.P., °F.	212-662°		203-662°	
Yield of Product Percent Weight on Feed	99+		99+	
Sulphur Removal, Percent	84.5		84.9	
	Feed	Product	Feed	Product
Specific Gravity, 60° F.	0.8005	0.7975	0.8285	0.8220
Gravity, °A.P.I.	45.3	45.9	39.3	40.6
Distillation:				
I.B.P., °F.	193	.....	255	243
10 Percent Volume at °F.	249	.....	302	291
50 Percent Volume at °F.	407	.....	448	437
90 Percent Volume at °F.	594	.....	604	590
End Point, °F.	653	.....	639	626
Sulphur, Percent	0.387	0.06	1.15	0.174
Naphtha Fraction:				
T.B.P., °F.	I.B.P.-356°	I.B.P.-356°	I.B.-356°	I.B.P.-356°
Yield, Percent Weight	34.8	37.9	30.1	31.6
Specific Gravity, 60° F	0.7585	0.7600	0.7805	0.7785
Gravity, °A.P.I.	52.6	54.7	49.8	50.3
Distillation:				
I.B.P., °F.	207	199	232	239
50 Percent Volume at °F.	279	276	289	289
End Point, °F.	367	361	369	363
Sulphur, Percent	0.081	0.002	0.302	0.0025
Sulphur Removal, Percent	.....	97.5	.....	99.2
Octane Number (Motor)	.....	45.0	47.6	52.0
Kerosine Fraction:				
T.B.P., °F.	356-482°	356-482°	356-482°	356-482°
Yield, Percent Weight	35.7	34.3	25.3	28.4
Specific Gravity, 60° F.	0.8085	0.8075	0.8180	0.8170
Gravity, °A.P.I.	43.5	43.7	41.5	41.7
Distillation:				
I.B.P., °F.	372	376	388	379
50 Percent Volume at °F.	418	417	415	412
End Point, °F.	480	475	484	459
Sulphur, Percent	0.243	0.015	0.694	0.057
Sulphur Removal, Percent	.....	93.8	.....	91.8
Gas Oil Fraction:				
T.B.P., °F.	482°+	482°+	482°+	482°+
Yield, Percent Weight	29.5	27.8	44.6	40.0
Specific Gravity, 60° F.	0.8410	0.8440	0.8720	0.8635
Gravity, °A.P.I.	36.8	36.1	30.8	32.4
Distillation:				
I.B.P., °F.	509	507	520	514
50 Percent Volume at °F.	549	541	568	560
End Point, °F.	655	639	664	658
Sulphur, Percent	0.89	0.23	1.79	0.384
Sulphur Removal, Percent	.....	74.2	.....	78.5
Diesel Index	.....	59	46	48

TABLE 5

Autofining of Aromatic SO_2 Extracts

	Extract From Middle East Naphtha		Extract From Middle East Kerosine	
Yield of Product Percent Weight	97.5		97.0	
Sulphur Removal, Percent	98.6		92.5	
Catalyst on-stream Period, Hours	200		200	
	Feed	Product	Feed	Product
Specific Gravity, 60° F.	0.836	0.835	0.869	0.864
Gravity, °A.P.I.	37.8	38.0	31.3	32.3
Distillation:				
I.B.P., °F.	239	230	311	286
5 Percent at °F.	246	243	329	318
10 Percent at °F.	248	246	338	327
50 Percent at °F.	264	261	372	369
90 Percent at °F.	293	291	451	451
End Point, °F.	325	327	489	496
Octane Number (Motor)	85.3	87.2	.....	.....
Aromatics, Percent Weight	78.1	76.2	75.5	73.8
Color—Saybolt	+15	+27	0	+22
Sulphur, Percent	0.295	0.004	0.692	0.052

extraction of gasoline and kerosine fractions. (See Table 5.) The process is not normally applicable to residual fuel oils containing asphalt.

Utilities Requirements

The expected consumptions of utilities in the 3500 barrel-per-stream-day commercial unit at Llandarcy are given below:

150 Pound Steam—6000 pound per hour (net).

Cooling Water—30,000 Imperial gallons per hour.

Fuel—25 million BTU per hour.

Electric Power—10 Kilowatts.

In this plant the recycle gas compressor is steam driven and steam is generated in a waste heat boiler.

Investment Costs

The 3500 barrel-per-stream-day commercial plant built in 1951 will have a total erected cost within battery limits of approximately ($700,000). Of this total cost, materials including common building materials, drafting, engineering, procurement and contractors' overhead and profit, will amount to $549,000.

Licensing

This process is covered by patents or patent applications in all major countries and is available for licensing by Anglo-Iranian Oil Company Ltd., London, England.

New Lube Oil Classification System Announced by API

The new system of service classifications and designations for automotive lubricating oils has been announced by the Lubrication Committee of the American Petroleum Institute. The new nomenclature was approved by the API board of directors at a meeting in Tulsa, Okla., recently. It has been approved previously by the API's Marketing Division, by the American Society for Testing Materials and the automotive industry. The new classifications were devised after it became apparent that advances in additive-treated motor oils had made existing crankcase oil terminology inadequate and obsolete.

The new classifications are: **Service MS**—Service typical of gasoline or other spark ignition engines operating under unfavorable or severe types of service conditions and where there are special lubrication requirements for deposit or bearing corrosion control, due to operating conditions or to fuel or to engine design characteristics. **Service MM**—Service typical of gasoline and other spark ignition engines operating under moderate to severe service conditions, but presenting problems of deposit or bearing corrosion control when crankcase oil temperatures are high. **Service ML**—Service typical of gasoline and other spark ignition engines operating under light and favorable service conditions, the engines having no special lubrication requirements and having no design characteristics sensitive to deposit formation. **Service DG**—Service typical of diesel engines in any operation where there are no exceptionally severe requirements for wear or deposit control due to fuel or to engine design characteristics. **Service DS**—Service typical of diesel engines operating under extremely severe conditions or having design characteristics or using fuel tending to produce abnormal wear or deposits.

* * *

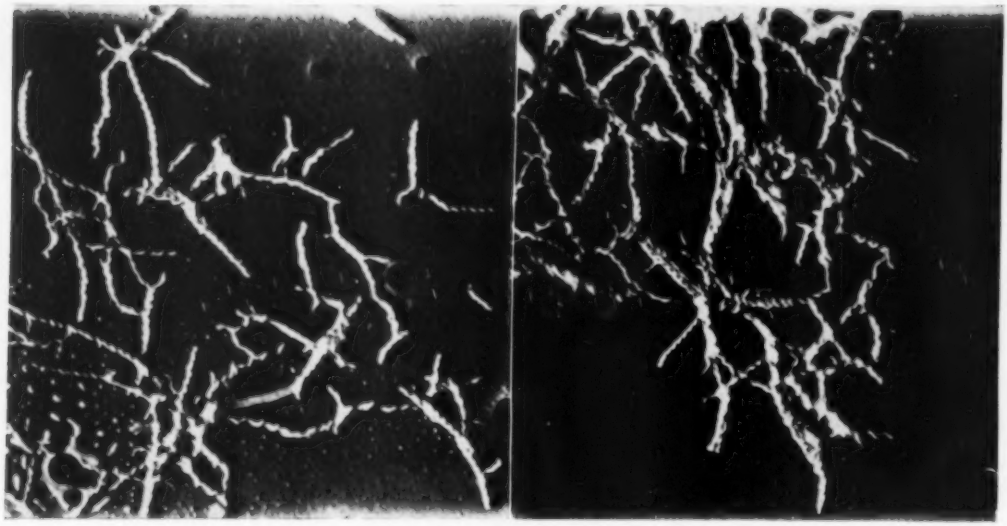


Figure 1—Typical Lime-Base Grease Fibers—Figure 2.

Take a Look at Lime-Base Greases Through an Electron Microscope

Sub-microscopic studies of fiber structure seem to have opened up broad field of study

W. A. CUNNINGHAM and M. A. VELA
The University of Texas, Austin

THE nature and characteristics of the submicroscopic metal soap fibers have been the subject of considerable study, and various data have been published concerning their size and structural peculiarities.[1, 4, 5, 7, 8, 12, 13] However correlative data have been difficult to obtain because of the complexity of the variables and the difficulties involved in isolation and examination of the extremely small particles. Vold and coworkers[11] have published the results of an extensive investigation covering pure metal soaps of fatty acids and of the soaps dispersed in various hydrocarbon mixtures.

Because of the nature of the grease fibers, investigations until recent years largely have been restricted to theory and deductive reasoning, but X-ray and electron microscope techniques now available have opened up new areas of study. Ellis,[2] using an electron microscope, found that calcium-base grease fibers apparently were twisted as in a two-stranded rope. He identified three distinct forms: a) one with both strands wound around each other in rope fashion, b) one with one strand straight and the other wound around it, c) and a third braided form with a line of symmetry coinciding with the axis. Farrington[3, 4] and Mottlau[9] have also reported similar fiber structures. Fibers generally have been believed to be rounded in cross-section, though Mottlau in a comparison of shadow-cast and non-shadowed specimens, speculated briefly on the possibility of a ribbon-like structure.

One limitation on the use of the electron microscope has been the difficult problem of grease sample preparation. Soap particles in the grease are extremely thin and offer only slightly more opacity to the electron beam than does the parlodion film on which the specimen normally is mounted. In fact, many parts of the fibers are "invisible" since they appear as transparent as is the film itself. The examination is further hindered because oil tends to scatter the beam and render the fibers almost indistinguishable. Hence, the oil must be removed by some means which, if possible, does not disturb fiber orientation. Various techniques have been described by the investigators just mentioned. Most of the methods described are similar in that they consist of a means of depositing a thin film of grease and then removing the oil with a suitable solvent. Preparation of thin sections varying from 0.05 to 0.1 microns in thickness by slicing frozen blocks of grease with a microtome has been attempted with varying degrees of success.

In this study, electron micrographs were made of specimens of six lime-base greases manufactured commercially by the same process and in the same plant. In addition to the methods of slide preparation previously reported two new ones were used, one of which proved to be quite useful. A tiny speck of grease was first deposited on the parlodion film surface and then spread into an extremely thin film with a high velocity jet of air blown through a fine hypodermic needle. This spread the grease into an extremely thin film and, as a result, many fibers were released from the oil media. By this method the grease fibers were distorted considerably, and, in many cases, torn apart in such a way that their appearance provided possible clues as to their stability and strength.

The behavior of the metal soaps in greases including the manner of fiber

Original presentation as "Electron Microscope Studies of the Fibre Structure of Lime Base Greases" was at the Seventh Southwest Regional Meeting of the American Chemical Society, Austin, Texas, December 7, 1951.

Vela's present address is Phillips Petroleum Company, Bartlesville, Okla.

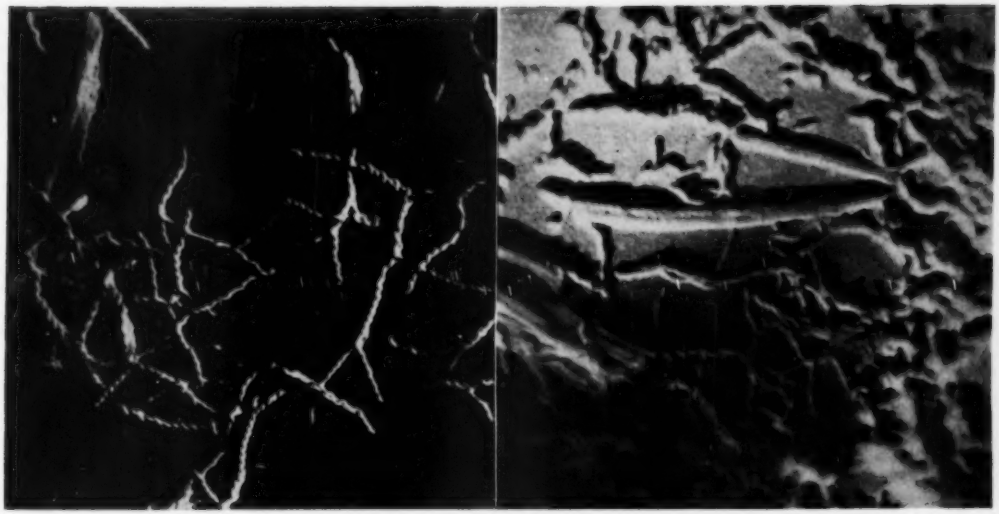


Figure 3—Note Fibers in Process of Formation from Crystallite—Figure 4.

formation has been the subject of considerable speculation. Lawrence[7] suggested a mechanism of fiber formation whereby, with increasing temperature, the oil penetrated between the hydrocarbon chains of the soap crystal lattice until the thermal disruption of the polar groups occurred. Gallay[6] believed the mechanism to comprise a series of stages—partial melting, shearing and then recrystallization. Southam[10] in 1947 postulated a "bidimensional melting" which allowed oil to penetrate the hydrocarbon chains after which shearing forces assisted the soap micelles in breaking loose to form fibers.

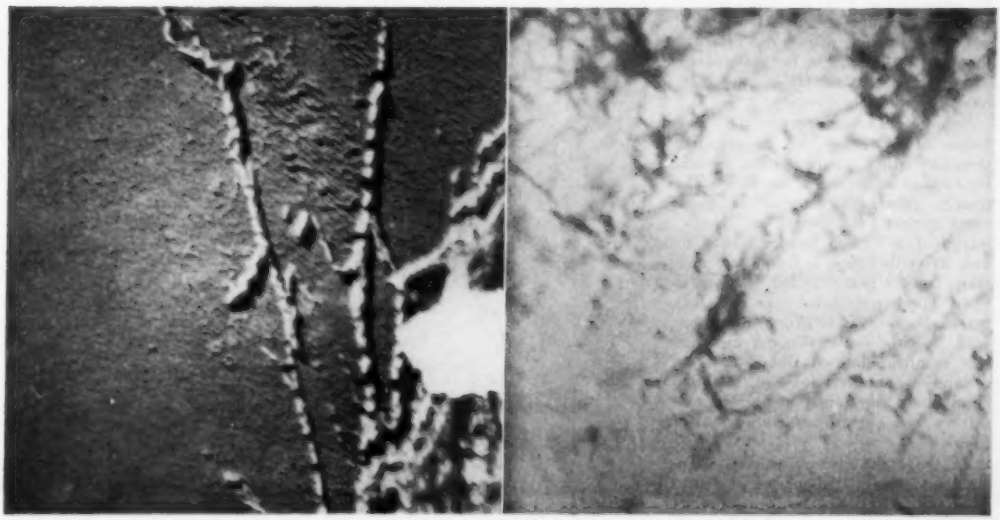
Because of the small field available for examination in any one electron micrograph, careful examination of a large number of pictures is required to establish the existence of a particular fiber structure with any degree of certainty. In this study some 250 specimens were examined and photographed. Obviously, only a very few can be presented here; the descriptions of observed fiber structure are based on observations based on all photographs made and illustrated with typical examples.

The predominating fiber structures were similar to those previously observed. The typical twisted, "rope-like," and "braided" fiber forms are shown in Figures 1 and 2.

In several instances, fibers apparently in the actual process of formation from crystallites were encountered. In Figure 3, a ribbon-like fiber appears to be peeling off from a crystalline mass, and the ribbon seems to be twisting and curling as it is sheared from the crystal.

In Figure 4, some detail of which

Figure 5—Fibers Isolated by Action of High-Velocity Air Jet—Figure 6.



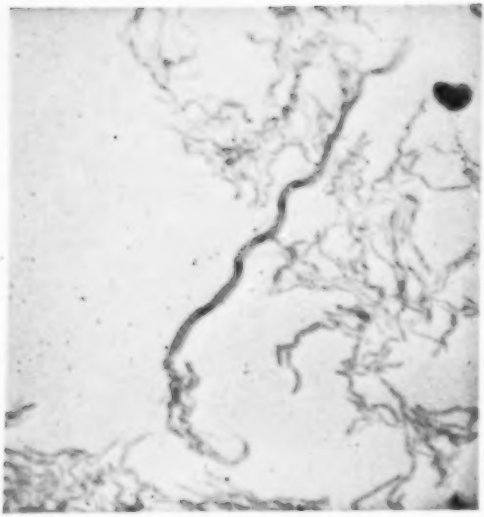


Figure 7. Fibers Isolated by Action of High-Velocity Air Jet. Figures 6 and 7 are unshadowed.

is lost by overshadowing with gold, are seen at least two good examples of fiber formation. At one end of the long semi-horizontal crystallite in the center is a curling fiber in process of separation which resembles a shaving cut with a sharp knife from a piece of soft wood. Nearby is an "asbestos-like" striated crystal mass from which a number of fibers are being separated.

Photomicrographs of grease specimens prepared by spreading the fibers with high-velocity air are shown in Figures 5, 6, and 7. The specimens photographed in Figures 6 and 7 were not shadow-cast with metal. All three of these pictures show that satisfactory fiber separation can be obtained and, by comparison with the fibers shown in other photographs, the air jet did not break up and distort the fibers to the extent that might be anticipated. This implies that the individual fibers have considerable strength.

Some of the micrographs show evidence of a ribbon-like or skin-like structure which would readily explain the twisted condition of the fibers. The density patterns of some of the specimens appear to represent an "X-ray" image of a ribbon twisted about its own axis; this type is frequently mistaken for the two-stranded "rope-like" fiber. The two-stranded type probably originates as a single ribbon which has split longitudinally along a cleavage line resulting in two ribbons twisted around one another. Some of the thick, rigid fibers apparently are large crystallites not yet broken into smaller fibers.

In the eight greases studied there was no strong correlation between fiber characteristics and physical properties. It is possible that, as others have suggested, the grease characteristics result from "secondary aggregations" of the fibers; some evidence has been found in micrographs that this aggregation may take the form of sponge-like agglomerates of fibers in oil (Figure 9). These sponge-like formations of fibers trap some oil within their mesh-work, and flow or move relative to each other in the grease. On setting, the enmeshing of the loose fibers of the different sponge-like masses, may be the cause of the thixotropic action in the greases.

Obviously, a full understanding of the structure of greases will require extensive studies of the many complex variables involved. Sub-microscopic studies of fiber structure apparently have opened up a rather broad field of study which should prove of value.

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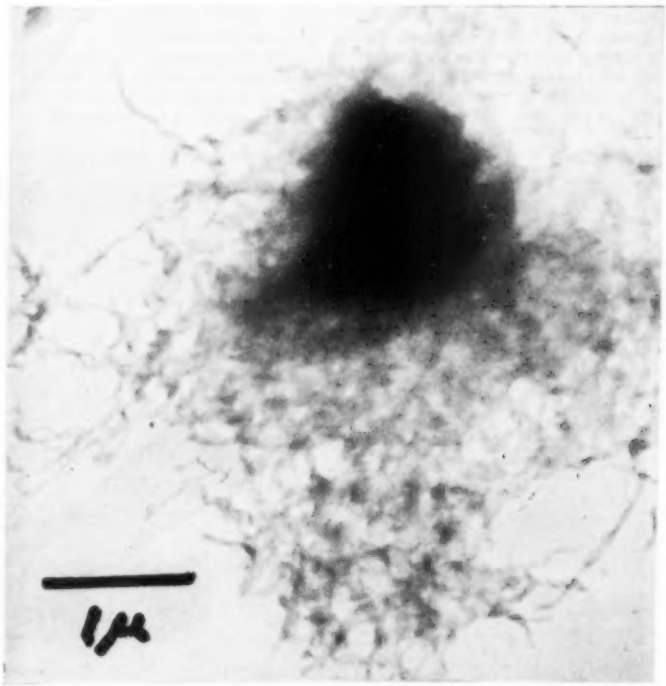
Figure 8. Sponge-Like Aggregate of Fibers.



Thermal Insulation for Industrial Requirements

Part IV. Design Considerations for Atmospheric Temperature Range Insulation

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THERE EXISTS no perfect insulation material that will satisfy all requirements of the design engineer; so the countless types and forms must each be evaluated in order to solve problems that arise in the processing industry. Such an evaluation should include a consideration of the thermal, physical, chemical, and moisture conditions, as well as safety, economics, availability, and time.

Introduced by Part I on basic considerations, this series has dealt with thermal insulation in the high temperature range in Parts II and III. Part IV outlines the design considerations for the atmospheric temperature range.

OF THE three general temperature ranges (elevated, atmospheric, and sub-zero) the most neglected is the atmospheric range. This is owing to the comparatively small difference between the operating temperature and the atmospheric temperature, which tends to make the problem appear small. This, however, is not always true.

Requirements of Installation

In this temperature range the thermal requirements may or may not be difficult to fulfill. In some instances, for example, hot water lines insulated to retard heat loss, the minimum insulation thickness available may be more than adequate. In other instances it may be necessary to hold process lines to a fine tolerance of heat gain or loss. This type of problem may be quite difficult to solve. Another problem which requires considerable thought is one where a process line is to be held to a constant temperature by the use of a heated tracer line within the insulation. This problem is one of heat balance, wherein the heat output of the tracer line must equal the heat loss from the surface of the insulation. If the temperature of the process line is to remain constant regardless of atmospheric conditions, the heat transfer from the tracer line must be controlled to compensate for the difference in surface losses caused by the fluctuation of atmospheric conditions.

Conductivity of insulation is generally determined by test when the insulation is in a dry state. The temperature drop through the insulation and the resultant surface temperature is insufficient to drive moisture from the insulation to the atmosphere, even when operating temperatures are near the top of the atmospheric range. Therefore it is unlikely that the insulation in service will be or remain as dry as the sample tested to determine conductivity. Of course, the lower the operating temperature, the more likely that the insulation will become wet. It is known that an excessive amount of moisture in insulation will increase its conductivity value. However, an insufficient number of tests have been made to determine the effect of various percentages of moisture on conductivity. Some allowances must be made for this increased conductivity value but the amount is still a matter of judgment based on experience.

Surrounding air temperature fluctuations cause a peculiar condition in this operating temperature range since in some cases the air temperature might be higher than the operating temperature and at other times the reverse is true. For example, if the oper-

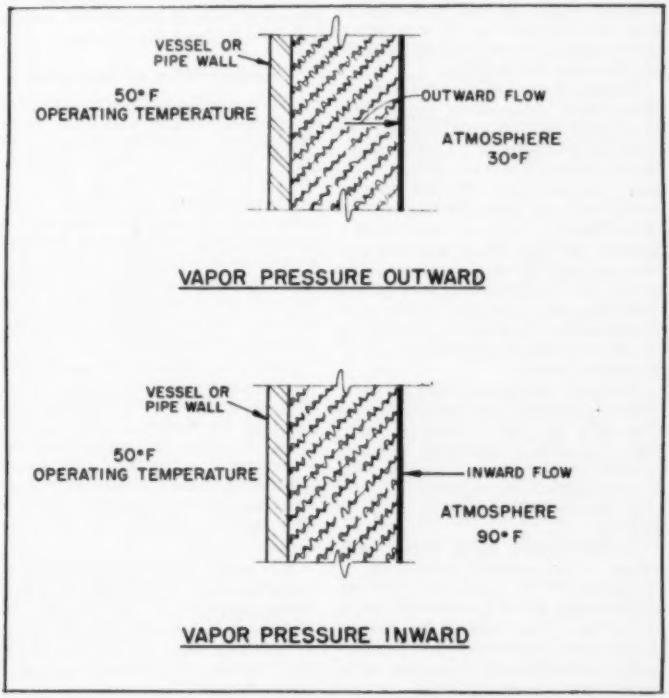


Figure 1. Diagram of Vapor Conditions

ating temperature were 50° F. in winter, the air temperature might be 30° F. and in this case vapor pressure would be outward or toward the low pressure side. In summer, however, the air temperature might be 90° F., in which case the vapor pressure would be inward. In the first case, vapor barrier on the outer surface of the insulation would retard the escape of any moisture in the insulation. In the second case just the opposite is true, the vapor membrane on the outer surface would retard moisture entering into the insulation from the surrounding air. Under these conditions the only solution is to be sure that the insulation is dry at the time of its application and remains dry until the outer vapor membrane is completely installed and sealed. A diagram of the vapor conditions described are shown in Figure 1.

Severe Physical Requirements

Physical requirements for insulation used in this temperature range may be quite severe. Moisture will cause many insulation materials to become soft and lose their strength, and even though all precautions are exercised in applying and installing vapor barriers on the outer surface, moisture will eventually get into the insulation. Therefore, it is important that any insulation used in this service should be able to withstand considerable water or moisture without losing its strength or otherwise deteriorating.

Rusting is more of a problem in the atmospheric temperature range than at elevated temperatures because more moisture is likely to be retained by the insulation. Whenever air and moisture come in contact with iron, rusting is always a problem. Rusting can be controlled by using a rust-resistant coating over the pipe or vessel before the application of insulation. This protective coating must be applied with care as a pin-point break may cause rusting to start and eventually result in a complete breakdown of the protective coating.

Chemical corrosion is also possible. Water in contact with some insulations can cause an acid or alkaline solution. It is well to determine that any solution formed through reaction with the insulation will not adversely react with the metal to which it is to be applied.

Another action which might occur owing to the presence of moisture in insulation is that galvanic electrical currents may be set up when any metal dissimilar to the metal of the pipe or vessel is so located that an electrical path can be formed. Strapping, wire mesh, wire, or other insulation securements are frequently not of the same metal as the surface being insulated. When insulation is dry its electrical resistance is high and little or no current can flow through it. When the insulation is damp, however, battery action will occur. Where it is impossible to maintain dry insulation and where dissimilar metals are present, some means of protection against galvanic action should be provided. This may be accomplished by the use of a high electrical resistant coating or barrier on the pipe or vessel, or counter-electromotive forces may be set up to neutralize the galvanic currents.

Most insulations used in the elevated temperature range are fire-resistant but in the atmospheric temperature range materials may be used which are not fire-resistant. Before any such material is used, the location of the installation should be studied to determine the hazard involved. Since no material is fireproof, insulations located in hazardous areas must be chosen with care.

In this moderate temperature range, heat savings may not be the most important factor required of the insulation. Because it may be difficult to justify insulation on the basis of savings, the first cost may have to be kept very low. Therefore it is not only necessary to keep in mind the function of the insulation in service, but also the workability of the material and its influence on application costs.

Characteristics of Insulation

When installation requirements have been evaluated, the insulation under consideration should be studied as to its 1) thermal, 2) physical, 3) moisture, 4) chemical and 5) electrical properties in order to fulfill these requirements. No one insulation has all the properties desired, so it becomes a question of compromise to determine which insulation most nearly fulfills the most important requirements, with at least a minimum fulfillment of the remaining requirements.

Of course, some of the weaknesses may be compensated for in the proper selection and use of accessories. For example, insufficient tensile strength might be offset by reinforcing the outer surface of the insulation with a reinforcing mesh. Inadequate vapor resistance may be overcome by the use of a vapor barrier film on the outer surface.

Any of the more common types of insulation may be preferred for a particular application. These types are 1) fibrous, 2) granular, 3) cellular and 4) reflective, and may be furnished in rigid blocks or sheets, semi-rigid sheets, blankets, fill, or plastic form. Each has its own characteristics and each should be applied in a manner to best meet the operating requirements. The type of supports, method for application and securement, and the accessories needed are thus determined.

Protection of the Insulation

The first consideration of any installation is protection of the vessel or pipe to which the insulation is applied. This protection may or may not have been provided by someone other than the insulation design engineer. The next consideration is protection of the insulation. Insulation must be secured and supported. This becomes more difficult where severe vibration or physical movement is present in the pipe or vessel. Insulation must be protected from moisture, both in the liquid and vapor phases and, if located outdoors, must be protected from the elements. Insulation located where it may be subjected to physical abuse, such as being walked upon, leaned against, or bumped, should be protected with a rigid jacket or otherwise shielded.

Protection against chemicals or fumes is often the most difficult problem of an installation. In instances where this is important, protection of every accessory as well as the insulation itself must be considered. There is no ready answer in cases of this kind and each must be solved as determined by the conditions involved.

In addition to having the protective qualities already mentioned, the coating or jacket should also provide the insulation with an acceptable appearance.

Tests of Insulation

It has been mentioned previously that more tests are needed to measure the properties of insulation and its accessories. However, in many instances it might be sufficient to observe the properties of an insulation by handling, breaking, or by some other simple procedure. Of course, definite values cannot be established for such crude methods, but such simple observations by competent inspection may at least indicate the relative characteristics of the insulation in question. Tests should be devised just as quickly as possible for the use of the consumer to help him obtain the proper materials for his application. A few of the important things to be observed or tested are listed below.

I Chemical Properties
- 1) Chemical Composition of the Material
- 2) Alkalinity or Acidity
- 3) Reaction or Inertness of the Insulation with Chemicals

4) Temperature Properties
   A) Flame Point
   B) Flash Point
   C) Auto Ignition Point
   D) Melting Point

II Physical Properties
1) Strength
   A) Compressjon
   B) Tensile
   C) Flexural
   D) Impact
   E) Shear
   F) Hardness
2) Coefficient of Expansion
3) Shrinkage
4) Thermal
   A) Conductivity
   B) Specific Heat
   C) Emissivity
   D) Absorptivity
   E) Resistance to Flame Impingement
5) Moisture
   A) Vapor Migration Rate
   B) Hygroscopicity
   C) Effect of Moisture on other Properties
      a. Vapor
      b. Liquid
6) Electrical
   A) Resistance to Electrical Flow
   B) Resistance to Possible Galvanic Currents
7) Workability
   A) Cutting
   B) Fitting
   C) Forming
   D) Bending
   E) Troweling
   F) Spraying
   G) Brushing

Each material has specific properties and a material which has high compression strength would probably not have good bending characteristics. The test results do not necessarily indicate that one material is better than another, but rather determine which material is best suited for a particular application.

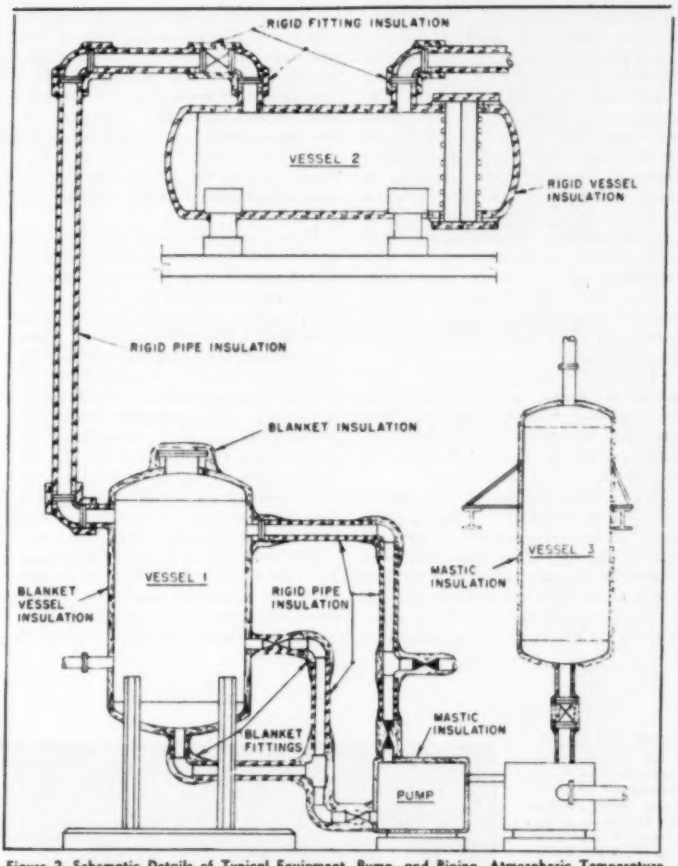


Figure 2. Schematic Details of Typical Equipment, Pump, and Piping, Atmospheric Temperature Insulation

Insulation Design

Each problem should be analyzed to obtain a complete understanding of its needs. In the atmospheric temperature range, too frequently insufficient time is spent obtaining the facts necessary for proper calculation of the resistance to heat flow, to obtain the desired results.

To assist in listing the points which should be considered, a few questions are in order:

1) What are the design, maximum and minimum operating temperatures of the pipe or vessel?
2) What are the average, maximum and minimum ambient air temperatures?
3) What are the average and maximum wind velocities?
4) What is the maximum or minimum allowable heat loss?
5) If cold, what is the maximum or minimum allowable heat gain?
6) What are the radiation effects of surrounding objects?
7) If outdoors, what is the solar effect?
8) If outdoors, what effect will rain or snow have on the heat loss?
9) What time lag can be allowed for heating or cooling, as the case may be?
10) What is the freezing temperature of the liquid in the pipe or vessel?
11) What is the boiling temperature of the liquid in the pipe or vessel?
12) What is the maximum or minimum flow of material in the pipe?
13) What is the density, specific heat and temperature of material in vessel or pipe?
14) What is the storage time of the material in the vessel?
15) What is the allowable temperature drop or rise of the material in storage?
16) What amount of heat is supplied by coils or tracing?
17) What amount of cooling is supplied?
18) What is length of pipe?
19) What is allowable temperature drop or gain in the given length of pipe at given flow?
20) What is the fire hazard of the installation?

Each particular problem will not require answers to all the questions listed above, but many may involve questions not listed.

When the thermal conditions are discerned and the physical and chemical properties established, the insulation is chosen which will best serve the needs. The methods of securement and protective coatings or jackets to best apply and maintain the insulation are then selected.

The fundamental sketch shown in Figure 2 illustrates various types of insulation which might be used for applications in the atmospheric temperature range.

Vessel 1 is shown insulated with a blanket type of insulation. Blankets may be of mineral wool, hair felt or other fibrous materials.

Vessel 2 is shown insulated with a rigid material of fibrous, granular or cellular type.

Vessel 3 is shown insulated with a bituminous plastic insulation. Little has been said about bituminous plastic or mastic insulations, but they can

frequently be employed in this temperature range to good advantage. Some are made for spraying onto the surface while others are of a troweling consistency. In cases where the temperature is not too high and the thermal requirement is not too great some of the mastics made with bituminous materials have quite an advantage in their resistance to corrosion. When cost is a big factor, these materials may be applied at considerably less cost than the more standard types of insulation.

The piping from Vessel 1 to Vessel 2 is shown as a typical rigid sectional insulation job with built-up rigid block fittings.

The piping from Vessel 1 to the pump is shown as rigid insulation with built-up blanket fittings. Pipe may also be built up of blanket insulation; however, this is not shown on the sketch.

One caution should be observed in the insulation of any equipment or pipe in this temperature range and that is the use of as little water-mix materials as possible. The operating temperatures are not sufficiently high to drive out the moisture from water-mix materials in a short period of time. If located outdoors, rain might continue to wet water-mix cements unless rain sheds are carefully maintained. No finish or weather protection should be applied over a wet surface. Where absolutely necessary to use water-mixed insulating cements, it is well to consider the use of a hydraulic-setting insulating cement and provide additional drying facilities if possible.

Piping and equipment are frequently insulated to "prevent freezing" of the liquids which they contain. It should be remembered, however, that insulating material alone can not prevent freezing; it can only retard it. Some heat will always be transferred through insulation and, if no additional heat is added, freezing will eventually occur in piping and equipment when the temperature of the surrounding air drops below that at which the liquids will remain in a fluid state. If, however, heat is added by flow of material into the container, or by other means, then insulation can be installed in sufficient thickness so that the total maximum heat loss will balance or be less than the minimum heat gain. Under these conditions no freezing will occur.

In these days of critical materials it is well to check the availability of all materials before a choice is made. The best material is of no value if it cannot be obtained. The availability of accessories may also be a deciding factor. A good insulating material with improper securement or without proper accessories is of little value.

Finally, consideration should always be given to the matter of safety. All hot projections or spots where personnel might be burned, should be insulated. Above all, applications should be considered in reference to the possible fire hazard. Where such fire hazards exist, insulation or coatings which might add to the hazard should not be used.

This article deals with the atmospheric temperature range, and though not in complete detail, at least briefly calls attention to the most important of the many design considerations for insulation in this range.

The next will deal with specification and application details of insulation in the atmospheric temperature range.

End of Part IV. Part V will appear in an early issue.

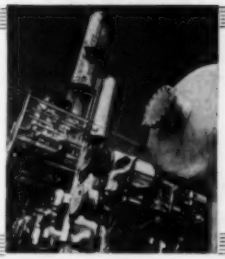
* * *

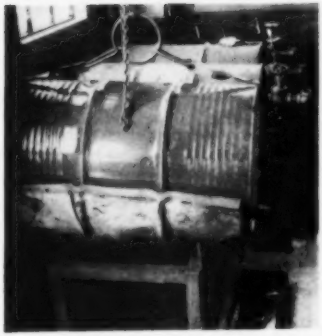
CITED FOR SAFETY—Stanley C. Hope, president of Esso Standard Oil Company, reads a citation awarded six of the company's plants by the National Safety Council, Petroleum Section, for safety records in 1951.

Left to right are Joseph E. Murphy, superintendent at Everett, Mass.; Charles B. Karns, manager, Pittsburgh works; Harold Mangelsdorf, superintendent, Bayway Refinery; President Hope; G. A. Esty, superintendent, Bayonne, N. J. and Stanley A. Wuchter, manager of Southern Works who received the award for the Charleston, S. C. Refinery.

Four Esso units were cited for "better than average" safety records in 1951 and for a reduction in their accident frequency rates. Two other plants, Charleston and Pittsburgh, were honored for completing two consecutive years without a disabling injury.

MAINTENANCE And OPERATION How To Do It—

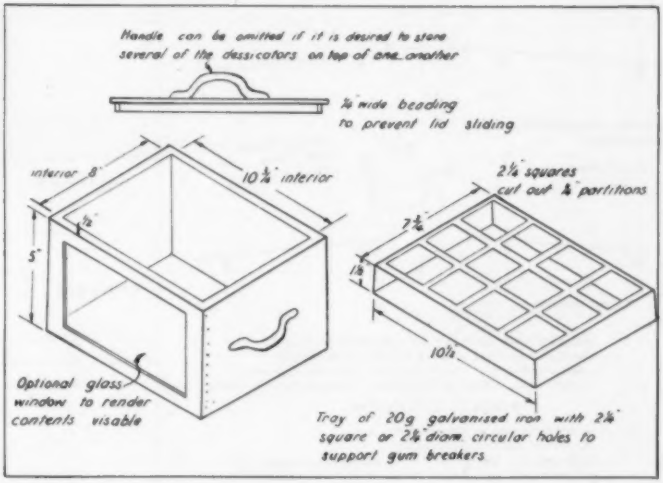




Heater for Steam Cylinder Oil

WHERE the viscosity of stream cylinder oil rises above the convenient pour point, the condition can be relieved by building a steam jacketed cradle for the barrel in which it is normally stored. The heater, or steam jacketed cradle, was made by splitting a conventional drum lengthwise after removing the heads below the chime. These two halves were spread slightly and joined at all seams with a narrow ribbon of similar steel. Small rods were passed through both halves as tie rods to prevent "ballooning" when slight steam pressure was admitted. Connections at each end were welded to the cradle for admission of steam and exhaust for condensate. This unit was built especially to operate on very low exhaust steam taken from pump exhaust and was not intended to be used on live steam at process pressures. The completed unit was mounted on an angle iron support, permanently attached with strap iron to prevent movement. The barrel of oil placed in the cradle is exposed constantly to the heat of exhaust steam and the contents pour freely regardless of room or outside temperature.

A Wooden Desiccator For Gum Testing


Handle can be omitted if it is desired to store several of the dessicators on top of one another
¾" wide beading to prevent lid sliding
interior 8"
10½" interior
½"
5"
2¼" squares cut out ¼" partitions
7½"
1½"
10½"
Optional glass window to render contents visable
Tray of 20g galvanized iron with 2¼" square or 2¼" diam. circular holes to support gum breakers

THE standard method for the determination of existant gum in gasoline (ASTM D 381-49) requires "a suitable covered vessel for colling the beakers before weighing.... The use of a drying agent is not recommended." The use of large glass desiccators for holding the beakers is commonplace though cumbersome in use and breakages can prove expensive. A wooden "desiccator" built somewhat similarly to a balance case as shown in the attached sketch proved most convenient in use for one chemist.

Varnishing the woodwork maintains the humidity conditions in the "desiccator" similar to those in the balance case. If required, a length of small diameter rubber tubing can be nailed round the top edge to give a reasonably tight seal from the weight of the lid. By using narrow headed brads and tapping sharply with the hammer, it is a simple matter to pass the heads through the upper wall of the tubing so that it is, in effect, nailed on by the lower wall only. If required, a jar of desiccant could be kept in the "desiccator" to simulate the conditions in the balance case.

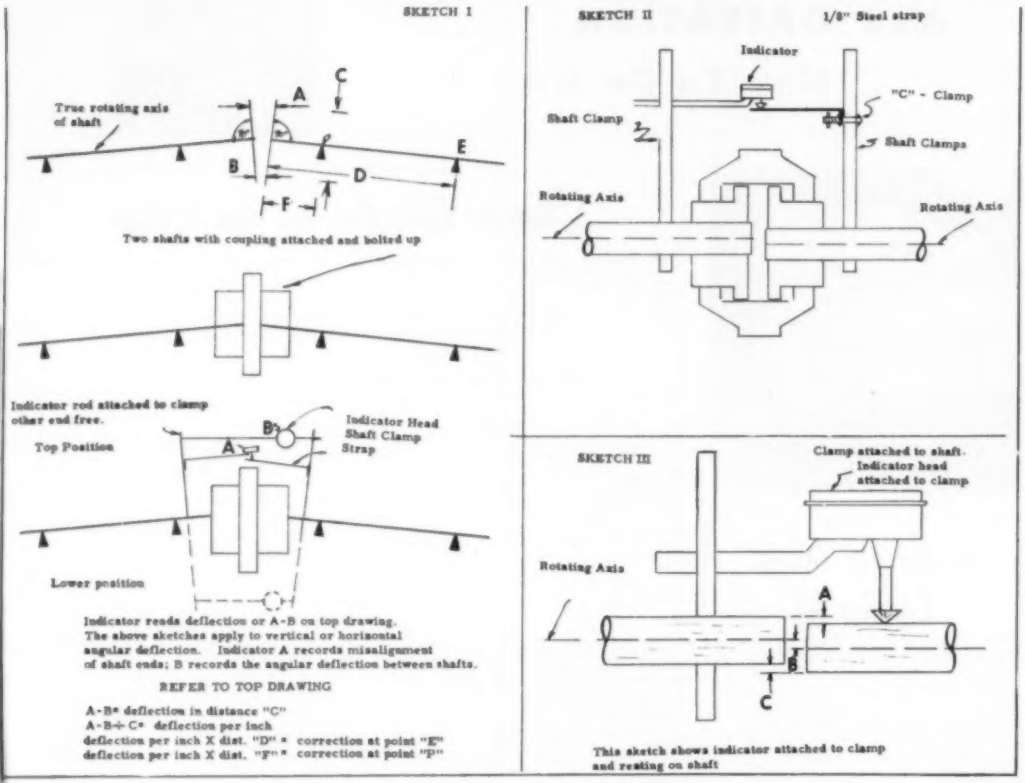
The use of a tray of galvanized iron with 2¼-inch square holes, each to hold one beaker, provides additional stability over the glass desiccator and thus further reduces breakages.

The "desiccator" shown holds 12 beakers safely and can be enlarged to hold more if required.

Maintenance and Operation Ideas Are Worth Money

Send your HOW TO DO IT suggestions with photos or sketches to Editor, Petroleum Refiner, Box 2608, Houston, Texas.

Axial Shaft Alignment



THIS method of shaft alignment is a departure from the usual method of using a taper gauge, straight edge or single indicator. The method is not radical but the results of using it are. It aligns the shafts from the rotating axis rather than from the external surfaces. For this reason it eliminates mis-alignment caused by crooked shafts and worn or eccentric bored couplings. This method works on the principle that a shaft supported in two places, when rotated, will turn on an axis located in the center of the shaft at the bearings where supported. The rotating axis will not be in the true shaft center, except at the support points, if the shaft is bent or sprung. When two shafts are aligned by this method, each shaft supported by two bearings, the rotating axis through the four bearings will be on a line, both vertical and horizontal. This method will show the angular deflection and vertical or horizontal mis-alignment of shafts from the rotating axis at the coupling.

To further explain the method, visualize a shaft being supported by two bearings as are pumps, electric motors and turbines. If a clamp with an arm projecting in line with the clamp is attached to one end of the shaft, the arm will be perpendicular to the shaft. When the shaft is rotated the clamp arm will rotate on the rotating axis regardless of the amount of kink in the shaft.

When two shafts are to be aligned, a clamp is placed on the end of each shaft and the coupling connected so the shafts will rotate together. By placing indicators on the clamp arms the amount of mis-alignment can be measured.

Referring to Sketch 1 the angular misalignment can be measured in both the vertical and horizontal planes when an indicator is placed between the clamp arms at point (A) and rotated to position (B). This will record the amount of deflection between the shafts' rotating axes in the distance (C). By turning the two shafts 360° a maximum and minimum distance between the arms will be found; these will be 180° apart. By attaching a piece of flat bar stock approximately ⅛-inch x 1-inch to one of the clamp arms with a small "C" clamp and then attaching an indicator to the other clamp arm, so placed that the indicator point will be in the approximate position of the shaft arm, the indicator will give the amount of deflection between the rotating axes when the indicator reading is divided by 2. By referring to Sketch III it will be noted that (A), (B) and (C) are equal. When the assembly is rotated the indicator will record (A) plus (C) which is twice (B). Therefore the indicator reading must be divided by two to determine the true value of the distance (B). If one shaft is required

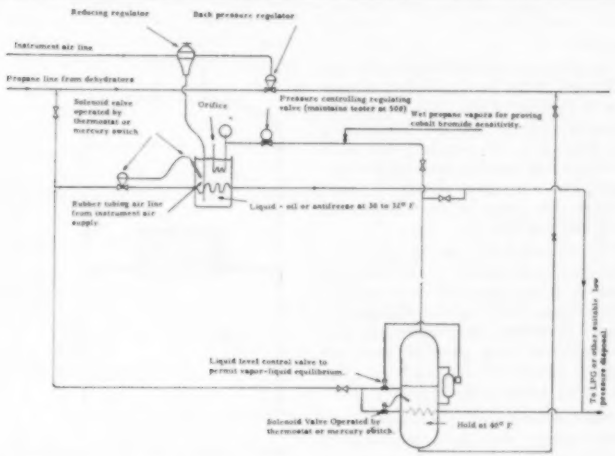
to be 0.010-inch low or high from the other shaft, the indicator reading will be 0.020-inch when the assembly is rotated through 180°.

To illustrate the success of this method the following example is cited. At one plant a multi-pump unit driven by a 150-hp. electric motor at 3580 rpm. had to be shutdown at least once a month to replace the packing or bearings in one or more of the pump units. This necessitated having the distillation down approximately four hours each time. This resulted in a loss of about 12,000 gallons of product. These units were checked repeatedly using the straight edge and taper gauge method on the couplings. They appeared to be in alignment.

When this unit was aligned by the method outlined above it operated 20 months before a shutdown. This shutdown was made to replace packing. Therefore on this one unit the saving realized amounted to 240,000 gallons of product.

—W. H. Weaver
Phillips Petroleum Company
Fullerton, Texas

Continuous Propane Dryness Tester


Reducing regulator
Back pressure regulator
Instrument air line
Propane line from dehydrators
Solenoid valve operated by thermostat or mercury switch
Orifice
Pressure controlling regulating valve (maintains tester at 500)
Wet propane vapors for proving cobalt bromide sensitivity.
Rubber tubing air line from instrument air supply
Liquid - oil or antifreeze at 30 to 32° F
Liquid level control valve to permit vapor-liquid equilibrium.
To LPG or other suitable low pressure disposal
Solenoid Valve Operated by thermostat or mercury switch.
Hold at 40° F

WHERE it was desired to tell at a glance if liquid propane passing through a line will meet dryness specifications, the apparatus in the sketch was installed for continuous analysis. The tester was installed in a manner which allowed a small side stream of the liquid propane from the rundown line to storage to be directed through the tester. This tester consists of two essential parts. One part includes the small vaporizing chamber which has a controlled liquid level and temperature, allowing the propane liquid and vapor to reach equilibrium at a temperature of 40° F.

The second part is a modification of the conventional cobalt bromide propane dryness tester in which the bath is maintained at a constant temperature (30-32° F.) by use of a coil through which liquid propane is expanded and by use of an open air line extending to the bottom of the bath. A pressure regulator is used to maintain the 50 pounds pressure required by the conventional tester. A solution of anti-freeze is used in place of water in the bath.

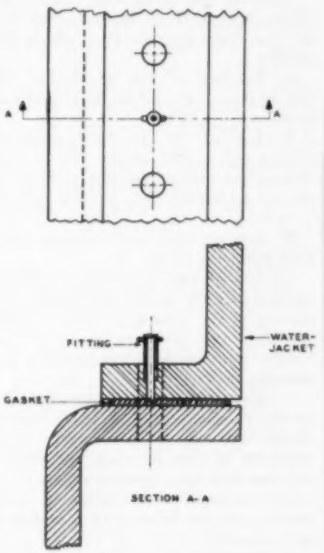
As the continuous tester is in operation, the liquid propane enters the vaporizing chamber, vaporizes, and then passes through the regulator to the cooling coil. After contacting the cobalt bromide indicator, the vapors exhaust through the orifice to the atmosphere. If the indicator remains green or blue, the propane is said to meet dryness specifications.

—W. L. Covington and
W. A. Allexson,
Shell Oil Company,
Notrees, Texas.

NOTE

The maintenance and operation hints on these pages are the prize winning "Operation Kinks" from the Panhandle-Plains Regional Meeting of NGAA, Amarillo, Texas, November 20, 1951.

Stopping Gasket Leaks



WHEN a gasket leaks in a situation where a shutdown or considerable time would be required to facilitate repairs, the expedient method shown in sketch may be used to plug the leak without having to replace the gasket. First, a hole is drilled through one into the gasket. The hole is tapped to take a grease fitting. The next step is to load a grease gun with gasket cement. Finally, the cement is shot into the gasket.

This method was successfully employed to repair a gasket leak between the water jacket and crankcase on a dual fuel engine, where a large stream of water was running through the gasket. To replace the gasket in this case, a five-day shutdown and labor bill of about $600 would have been required. Using the method described, no shutdown was required and only 20 minutes were required to repair the leak.

—George Needham
Phillips Petroleum Company
Hobbs, N. M.

Have You Solved These Absorption Plant Problems?

Two Warren Petroleum Corporation engineers give their solutions to common problems encountered in plants operating at 500 to 1200 psig

R. L. LANE and B. J. THOMPSON
Warren Petroleum Corporation, Tulsa

THE carry-over or loss of absorption oil overhead from the absorber with the residue gas stream presents several significant problems among which are a) the cost of make-up oil lost from the absorption system and b) the fouling of dry desiccant type dehydrator beds.

Various operators have employed different methods of counteracting the oil loss from the absorber which include:

a) Feeding of the absorption oil two or more trays below the top of the tower;

b) Use of 210 to 230 molecular weight oil instead of the 160 to 190 molecular weight commonly used in plants extracting high percentages of propane;

c) Internal tray and chimney type mist extractor units;

d) Use of vane type mist extractor elements which have been installed in the top of the absorber, in the residue scrubber and, in some cases, in the residue gas line downstream from the scrubber;

e) Use of mesh type extractor elements ranging from 4 to 6 inches thick, some of which cover the full diameter of the absorber and others are installed in a holding case with a predetermined cross sectional area based on a gas velocity of 1 to 4 feet per second; and

f) Providing a residue gas contact chamber packed with an adsorbing medium such as bauxite.

Various types of extractor elements have been used and most units have satisfactorily removed mechanically entrained liquid from gas streams. The problem of removing oil fog from an absorber residue gas stream has not been solved in our company's operating experience. Other operators may have favorable experiences to report on this problem.

In an effort to solve this extraction "toughie," several mesh type elements, as shown in Figure 1, have been installed in the top section of absorbers and residue gas scrubbers.

Operating experience has proven that the mesh element must be installed in a horizontal position. Several operating observations show a substantial reduction in the quantity of oil lost overhead from the absorber and residue gas scrubber when using a mesh type element.

Use of a precontactor unit as shown in Figure 2 has proven that a significant reduction of oil entering the dehydrator may be effected. Minimizing the amount of oil reaching the solid desiccant bed extends the ultimate desiccant life and makes possible a lower average dew point of the effluent gas from the dehydrator.

Oil collected in the precontactor drip may be manually or continuously drained. Spent desiccant is a satisfactory contact material for the precontactor. However, other materials may be employed that provide good adsorbing characteristics, such as silica gel, solva beads and charcoal.

Solid desiccant in dehydrators and precontactors may be regenerated to approach its original efficiency by

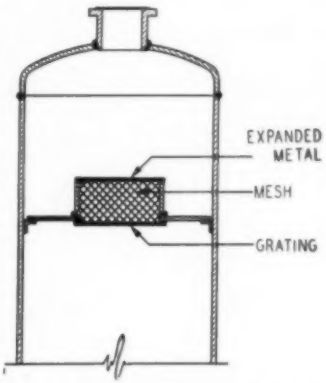


Figure 1. Typical Mesh-Type Extractor Installation in Top Section of Vessel.

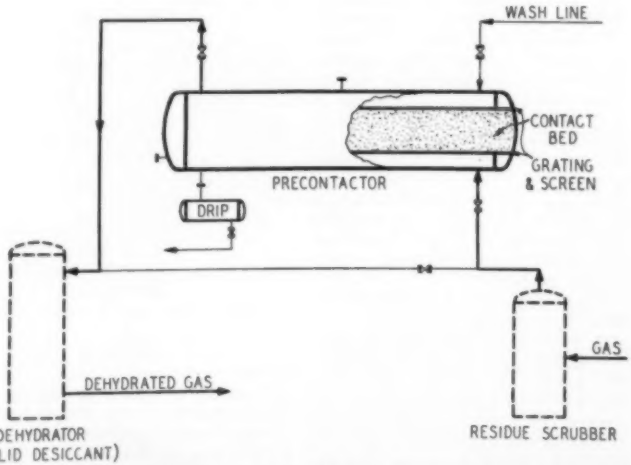


Figure 2. Precontactor Chamber Used Upstream from Dry Desiccant Dehydrator to Remove Oil from Gas Stream.

• Original presentation as "Absorption and Dry Distillation" was at the 31st annual convention of the Natural Gasoline Association of America, May 1, 1952, at Houston.

washing with natural gasoline or butane.

Foaming

Oils containing aromatic compounds appear to cause considerable foaming within the absorption process.

The desirable solution for the absorption oil foaming problem is to use an oil which has proven in operation to be satisfactory. There are numerous foam arresting compounds recommended for injection into the absorption system. The defoaming treatment has proven quite satisfactory to some operators.

Temperature Rise

The increase of absorption oil temperature, referred to as heat of absorption, as it flows down through the absorber must be coped with to maintain an optimum absorption efficiency.

The most common method of removing heat from rich oil in the absorber due to heat of absorption is by the use of intercoolers. These units consist of a liquid draw-off tray, a low-head pump and water cooled exchanger or atmospheric cooler. This type unit may be used from one to several times in one absorber as required depending on the richness of the gas and the percent of absorption desired. A special base cooling unit is being employed satisfactorily in plants absorbing rich gas. The base cooler unit is fed with rich gas and rich oil. The simultaneous absorption and cooling effects substantial absorption of propane and increasingly greater quantities of heavier hydrocarbons in the base cooler. Some intercooler systems consist of internal tube bundles mounted inside the absorption vessel which are cooled with water or a refrigerant circulating through the tubes.

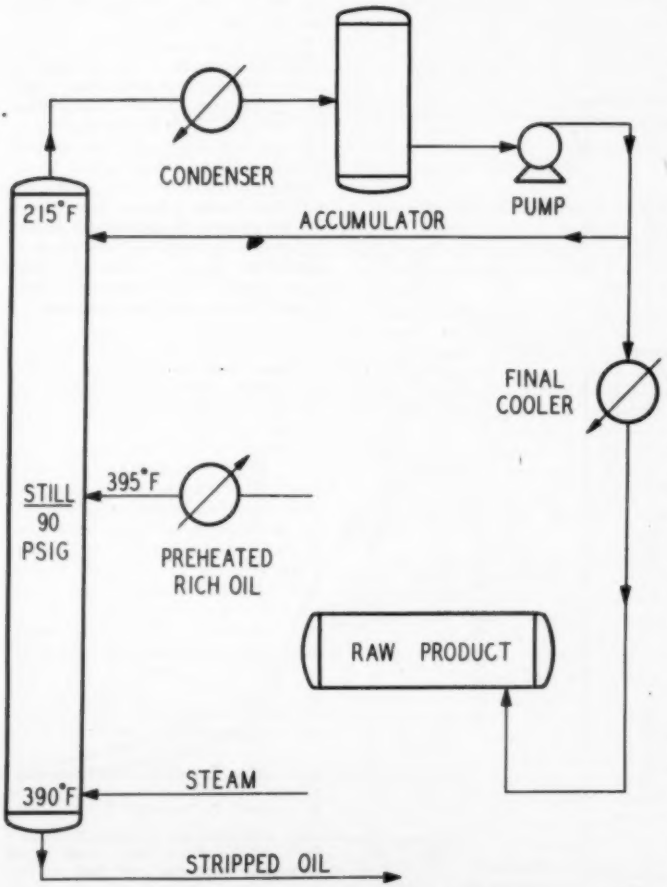


Figure 3. Typical Steam Distillation Flow Scheme.

Overload

Many operators have been confronted with the problem of handling a volume of gas considerably in excess to the design capacity of the absorber. The overloaded condition contributes to the previously enumerated absorber operation problems.

In some cases the increased load above the original design capacity is of such magnitude and projected duration to economically justify the installation of an additional absorption unit to operate in parallel with the original unit. In cases in which the average tray specifications or dimensions have been used, it is possible to redesign the existing trays for higher capacity or to replace trays with units having high capacity for the additional liquid and vapor loading.

Several tray designs are now on the market which the manufacturers claim will increase the capacity of the average existing absorber by as much as 50 percent.

Energy Conservation

Numerous absorption plant process arrangements include a major loss of available energy when the rich oil is flashed from absorber pressure, range 500 to 1200 psig, to the rich oil flash tank pressure which is commonly in the range of 200 to 300 psig.

Recent installations have been made to utilize this available energy in the relatively high-pressure drop from absorption to flash tank pressure. The high-pressure rich oil is circulated through a hydraulic or rotary unit used as a driver which is coupled to a similar unit utilized to pump some stream. A typical installation is to pump the lean absorption oil to the reabsorber. This type installation and others that may be worked out, offer attractive prospects for conservation of prime power by eliminating one or more electric or steam driven units. It is possible to recover as high as 70 percent of the available energy by the use of such a unit.

Dry Distillation

Before entering the discussion on dry distillation there will be reviewed briefly the general operating scheme of the various absorption oil stripping units.

Some operators are continuing to utilize the early day two-section distillation unit in which the first vessel is the stripping section from which the raw product vapors are delivered to a second tower known as the dephleg-

mator. Cool water is circulated downward through the dephlegmator to condense the raw product vapors from the stripping section. The presence of water in this type system, which originates from stripping steam and dephlegmator water, is a continuous problem due to corrosion and the additional load placed on product dehydrating facilities.

A common stripping scheme is to feed the preheated rich oil direct to a combination unit which consists of stripping and rectification sections in one vessel as shown in Figure 3.

In this system most of the hydrocarbon product will flash at or near the feed tray. Final stripping is accomplished by the introduction of steam below the bottom tray.

Some plants employ a multiple distillation system, using the primary or high pressure unit for maximum product condensation and the secondary or low pressure unit for the final separation of the gasoline from the oil. This system is particularly applicable in plants processing distillate.

In the past few years Warren has developed a dry distillation system which has proven to be quite successful. Dry distillation may be defined as a process employing hydrocarbon vapors to strip natural gasoline and lighter hydrocarbons from the absorption oil.

The general method of accomplishing this is shown by the simplified flow diagram in Figure 4.

In this system as well as in other stripping methods, it is desirable to bring the rich oil to the highest possible temperature before introduction into the still. Considerable amount of this heat is transferred to the rich oil by means of conventional oil to oil exchangers. At some point in this oil exchange system a flash drum is placed for the purpose of flashing the lighter hydrocarbons from the rich oil. Care should be taken to place this flash drum at such a point that low molecular weight vapors will be available for

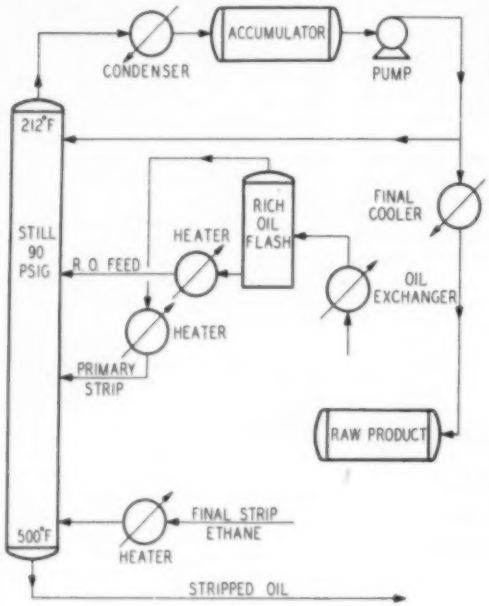


Figure 4. Typical Combination Hydrocarbon Stripping Scheme.

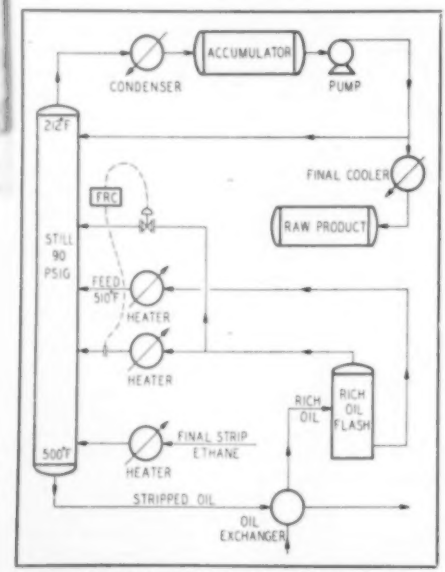


Figure 5. Combination Hydrocarbon Stripping Utilizing Excess Vapor Feature.

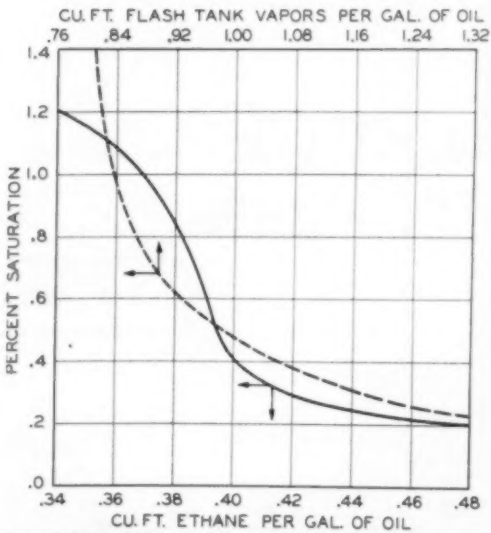


Figure 6. Effect of Changing Primary and Final Stripping Stream Rates on Lean Oil Presaturation.

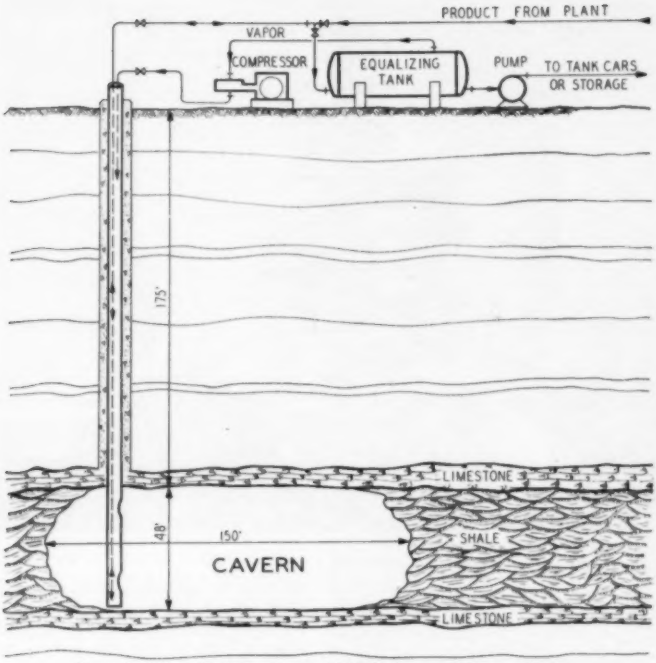


Figure 7. Schematic Arrangement of LPG Underground Storage System.

the primary stripping in the still. This process feature makes possible the utilization of desirable light stripping vapors which are inherently available in the rich oil stream. The final stripping vapor volume will be substantially reduced when used in conjunction with a primary stripping stream. The flash vapors are preheated as shown in Figure 4 before entering the still at approximately the midpoint of the stripping section and the preheated final stripping medium is introduced below the bottom tray.

In plants manufacturing propane the final strip vapors are taken from the overhead of the deethanizer column. These ethane vapors, like the primary strip vapors, are heated before being introduced into the still. By using a high purity ethane stream in this operation, the stripped oil saturation may be consistently maintained as low as one-fourth of one percent, and this saturation is essentially 100 percent ethane. This degree of saturation is satisfactory in plants recovering 80 percent of the propane.

The stripping scheme shown by Figure 5 is similar to the previous system except that it includes the feeding of the excess flash vapors from the flash drum to the rectification section. This feature does not decrease stripping efficiency and reduces the heating and cooling duties in the system. The ratio of primary stripping to excess vapor streams may be 3 to 1; however, the distribution must be determined for each still, depending on the rich oil composition.

Data taken from one operating plant as shown by Figure 6 establish the optimum ratio of primary to final stripping vapor as 2.6 to 1 for a still operating at 90 psig and 500° F. base temperature and using 180 molecular weight oil. The primary stripping vapors are fed at the rate of 1.16 cubic feet per gallon of lean oil circulation and the secondary or final strip vapors at the rate of 0.44 cubic feet per gallon.

On a tower such as just described, a feed temperature of 500° to 525° F. is most desired. This permits the minimum of final strip or agitation vapor; however, the stripping efficiency will be approximately the same if the feed is 450° F. and the final strip vapor volume is increased 10 percent.

Computations and operating experience have proven that 180 molecular weight absorption oil can be stripped to one-half of one percent saturation by use of a primary stripping medium only, with the complete elimination of final or secondary stripping medium. However this saturation is primarily of heavier hydrocarbons and is not desirable.

Residue gas has been used as a final stripping medium with success. This is to be avoided if at all possible due to added difficulties in the condensing of the still overhead vapors.

The hydrocarbon stripping operation has certain advantages over steam stripping and some limitations. Operating experience and design data should be employed to determine if a rich oil stream may be satisfactorily stripped by use of hydrocarbon vapors.

Some of the advantages of dry stripping are: a) elimination of a steam plant; b) the dry system reduces equipment corrosion; c) control equipment freeze-ups will be materially reduced and d) in plants which dehydrate the gas before it enters the absorber, propane or product dehydration may be eliminated.

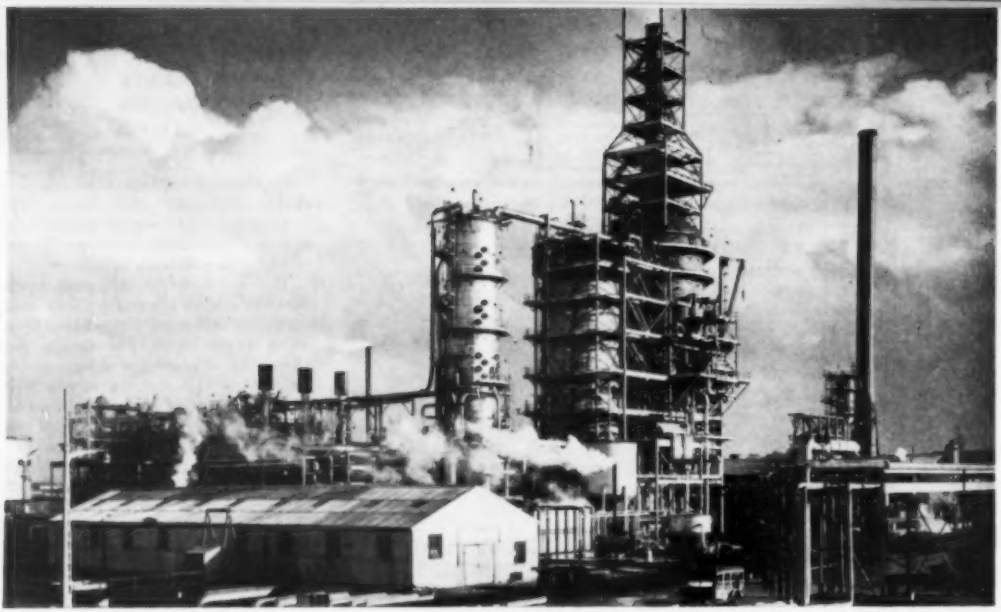
Disadvantages of hydrocarbon stripping include: a) A fixed recycle volume of noncondensed vapors and b) some added difficulty in condensing product vapors.

Considerable work has been done on the use of underground storage for the storing of butane and propane. One such operation which this company has used with success is at the Breckenridge plant in Stephens County, Texas, where a cavern was mined out to store 750,000 gallons of LPG.

After preliminary core drilling was completed a shaft 4 x 4-feet square was sunk to a depth of 223 feet, passing through a limestone formation at 175 feet and bottomed on another limestone formation. The shale between these two formations was removed creating a cavern of approximately 100,000 cubic feet. This cavern was not completed as a rectangular opening but was in the form of an inverted trapezoid with the width at the top approximately 35 feet and the bottom 18 feet wide.

The complete cavern and piping is shown diagramatically by Figure 7.

This cavern has been in use for over a year and has given very satisfactory results. After the first filling and evacuation the storage loss was slightly over 5 percent. The second filling resulted in a loss of about 2½ percent and it is believed that these losses will be negligible on the next evacuation. Evacuation of this cavern is accomplished by the use of recycle vapors through a compressor as shown by Figure 7. The product purity and color upon evacuation did not change at all and was equal to products being stored in steel storage containers.



The new cat cracker at Stanlow refinery, Cheshire, recently came into commercial production, turning out products at a rate of over one million tons a year.

Shell Completes Postwar Expansion Program in United Kingdom

New fluid cat cracker at Stanlow, now on stream, part of final stage of huge development plan

V. S. SWAMINATHAN
London, England

SHELL'S new fluid catalytic cracking unit at Stanlow refinery in Cheshire is in commercial operation, turning out products at a rate of more than one million tons a year. Built at a cost, including auxiliaries, of $22.4 million, its completion marks the final stage in the company's $84 million post-war refinery expansion program in the United Kingdom.

The catalytic cracker is noteworthy as signifying another stage in the close integration of Shell's adjacent petrochemicals plant with the refinery's operations. Now that the new unit is in production the chemical plant is enabled to increase its output of chemical solvents such as acetone. Moreover, it has resulted in the recovery of about 10,000 tons per annum of strategic sulfur, by providing the feedstock for the new sulfur recovery plant now in operation. Eventually, other by-products from the unit will serve as raw material for the manufacture of tetraethyl lead by Associated Ethyl Company at its new plant at Ellesmere Port, Cheshire.

Shell's enterprise at Stanlow includes the Thornton Research Center, started in 1939 as an aero-engine research laboratory. It now houses fuel and engine oil laboratories, wings for chemical and metallurgical work and for engine testing cells, as well as research laboratories for investigating the field of solvents and other petrochemicals. The group of laboratories for research on engine fuels and lubricants includes aero-engines and gas turbines, also on manufacture and use of chemicals from petroleum.

Beginning in 1922 as the site for discharge and storage of oil cargoes from overseas, the Stanlow plant up to the postwar period was devoted primarily to the production of specialty petroleum products such as asphalt, naphthas, and lube oils. Since the war a vast expansion program was adopted by the oil industry and Shell started building a new refinery at Stanlow, capable of treating about 3,250,000 tons of petroleum products a year. The petrochemical plant was opened on July 20, 1949.

In this installation gasoil is fed into the thermal cracking unit where it is cracked at high temperatures and low pressures under which the maximum quantity of gaseous products are formed. The cracked products are roughly separated into heavy fuel oil which is burned, and a mixture of light components. The latter mixture is fed into a gas separation unit, and split into five fractions: a mixture of light gases containing hydrogen, methane, ethane and ethylene which is burned; three other streams containing hydrocarbons with 3, 4 and 5 carbon atoms respectively, and a gasoline fraction.

The stream of hydrocarbons containing five carbon atoms is returned to the cracking furnace, and is further pyrolized. The two streams with three and four carbon atoms contain a high

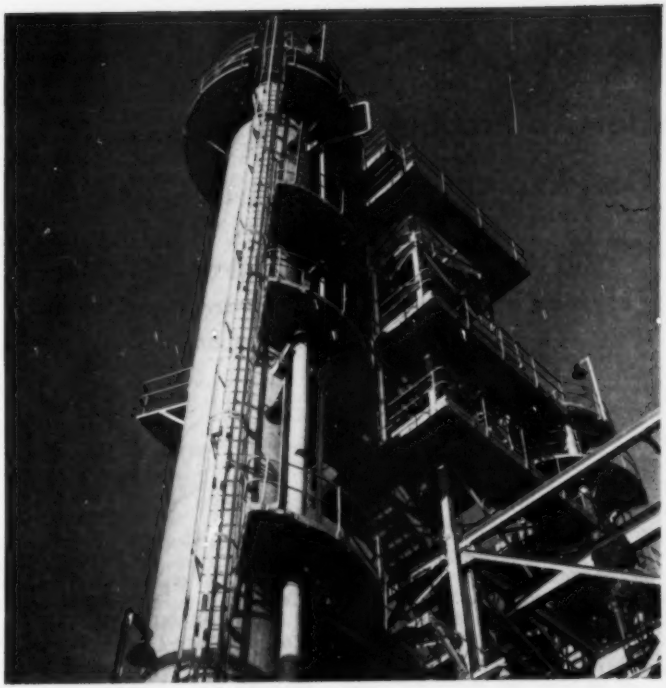
proportion of reactive olefins and it is these which form the feedstock for the manufacture of chemical solvents.

The C_3 fraction contains propane and propylene only, and it is allowed to react with sulfuric acid, in which the proylene is absorbed, forming the alkyl esters, while propane is unaffected. The acid solution is separated from the propane which, again after suitable treatment, is used as a fuel; the alkyl esters are hydrolyzed with water to produce crude isopropyl alcohol, which is separated from the acid by stripping with steam. Purification is effected by distillation.

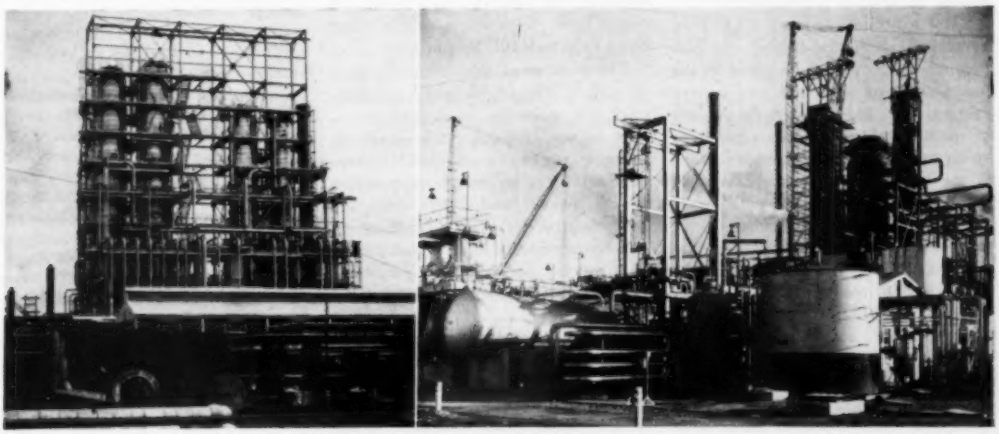
As the C_4 fraction contains other constituents beside butane and normal butylene it is chemically treated by extracting, with cold sulfuric acid of moderate strength which absorbs the undesirable isobutylene, but does not affect normal butylene. The purified normal butylene, together with butane, is used in the manufacture of secondary butyl alcohol. By heating to high temperatures under carefully controlled conditions, and in specially designed equipment, alcohols are broken down, into corresponding ketones, yielding hydrogen as a by-product. Isopropyl alcohol yields acetone, and secondary butyl alcohol methyl ethyl ketone. These two solvents are purified by distillation. Under suitable conditions acetone is converted into diacetone alcohol which, in turn, may be transformed into methyl isobutyl ketone via mesityl oxide. Farther distillation processes are for purification.

The first crude distillation unit at Stanlow (capacity one million tons a year) came on stream in November, 1949. The second, starting operation in June, 1951, trebled the plant's capacity to more than 3 million tons per annum. Output since has been stepped up to a yearly rate of 3.8 million tons. The 10,000 tons a year sulfur recovery plant started operation early this year. In addition to accounting for high quality petrol, gasoil, fuel oil, synthetic detergents and chemical solvents Stanlow refinery gases are utilized as raw materials for the company's chemicals-from-petroleum installation. The plant has also a catalytic cracking and reforming unit, a polymerization plant and facilities for final treatment of products.

The Stanlow catalytic cracker is Shell's second unit to go on stream in Europe, the first being that at Pernis near Rotterdam. A third cracker is to be erected at Berre-L'Etang near Marseilles in the south of France.



Depropanizer column on the Thermal Reforming unit.



At left above, the first of three crude distillation units was put on stream in 1949, processing Middle East crude oil. At right, the Stanlow doctor treater appears in the foreground with one of the crude distillations units in the background.

How To Prepare Preliminary Cost Evaluation Reports

"Quick evaluation" procedure will help chemical engineers in making reports upon which management depends heavily for decisions regarding expansion

PETER W. SHERWOOD
Chemical Engineer, Pittsburgh

PRELIMINARY cost estimates must be prepared at two stages of a properly integrated research program: 1) At the outset of a laboratory process study, and 2) before a laboratory-developed process is taken into the pilot plant.

At the first stage, available information is generally quite scant. The engineering estimate must therefore rely heavily on published data, on generalizations, assumptions, and inference. Nevertheless, a careful economic study at this point can prevent much waste by eliminating hopeless research projects. At the same time, this type of engineering evaluation serves as a valuable guide in establishing minimum requirements (of yield, throughput, etc.) which will make the proposed process economically feasible.

After a promising process has been developed in the laboratory, its economic feasibility must be tested by the preparation of a second preliminary cost estimate. At this stage, the amount of questionable assumptions has been vastly reduced by information gained in the laboratory. More reliance may therefore be placed in the outcome of this second study which must justify the expense of pilot plant investigations or, in many cases, even the much larger step to commercial production.

Beyond these two basic functions, the preliminary cost estimate serves in a variety of other instances. It may, for example, guide management's decision whether a proposed process should be carried out at an existing plant site or in a new locale. It will compare the economics of revamping existing facilities with the possibility of erecting a new processing unit. Furthermore, this type of report can test quite quickly the economic feasibility of an already developed process offered to the company by outside sources.

The key to this type of report lies in the words "quick evaluation." It differs thus in degree from a full engineering cost study which very often calls for a complete process design, together with plant specifications and layouts.

In order to fulfill its function of informing the reader concisely and accurately, the method of presenting a preliminary cost evaluation is all-important. It has been frequently found that reports prepared even by competent engineers and based on impeccable engineering methods fall down on this essential. As a result, the report lacks effectiveness, and in many cases fails to fulfill its purpose.

The purpose of this discussion is to present a scheme by which preliminary cost estimates, as defined above, may be standardized. Such standardization serves two functions: 1) it saves considerable time in the preparation of the report, and 2) it saves the reader's time by proper presentation and by permitting him to scan the report quickly for points of particular interest.

The standard report outlined in this article has been tested in numerous instances and has been found to cover the overwhelming majority of problems encountered in the preparation of preliminary cost estimates of the type defined above. Nevertheless, it must be realized that the variety of subjects encountered in the various phases of the chemical process industries precludes adherence to inflexible standards of form. The proposed guide should therefore not be construed to prevent the inclusion of material not therein mentioned, provided that such material will add to the value and lucidity of the report.

On the other hand, there may be instances when the full information cannot be presented in the cost report. Proper adjustment must then be made in the form of the report to retain the clarity which is essential to its preparation.

Letter of Transmittal

It is usually desirable to provide a letter of transmittal with each preliminary cost estimate. This letter should preferably not exceed two paragraphs and should state: 1) number of copies being transmitted, 2) the title of the report, 3) exact or approximate date when the work was requested, and 4) a reference to the background material (if available) which initiated the work.

Example: "Attached herewith are six (6) copies of a report entitled '————————,' prepared in accordance with your request of December 15, 1951.

"This work was undertaken following an inquiry received from XYZ Company (letter from Mr. A to Dr. B., dated November 28, 1951)."

The Report

1. Physical Form

Much is gained by good appearance of the report. Lettersize paper (8.5 x 11 inches) should be used. Sufficient margin should be left on each side of the typed page (at least 1¼ inch on the left-hand side, and ¾ inch on the right-hand side). The report may be single-spaced or double-spaced, although double-spacing is to be preferred for the text. Tabulations and equipment specifications are commonly single-spaced.

The use of a cover is almost always warranted. An attractive form may be given to the report by the use of two-part covers, made of soft cardboard, which may be held together by means of adjustable metal clips. Alternate forms include the use of plastic ring binders. In the case of particularly important reports, the use of cloth-bound covers may prove sound psychology, and even more luxurious methods of binding may be used.

The cover should always contain the following information:

TITLE

Date

Name of originating organization

It is often desirable to include also

the name of the report's authors or of the project number at this point.

In order to establish clearly the scope of the report, it is always desirable to include the words "Preliminary Cost Estimate" in the title.

Short reports (say ten pages or less) may begin on the page immediately following the cover. In the case of longer reports, it may be good policy to precede and follow the report with a blank sheet of high-grade paper. The first page should then be a title page stating substantially the same information as the outside cover. The second page should be an index to the various sections of the report.

2. Contents

The first page of the report proper (following the index page in the case of long reports) should restate the title in capital letters, underlined, at the top.

Example: "PRELIMINARY COST ESTIMATE FOR THE PRODUCTION OF 20 MILLION LBS./YEAR ACETYLENE BY THE PARTIAL OXIDATION OF METHANE."

The first paragraph should state the purpose of the report and briefly define the process involved.

Example: "The present report has been prepared for the purpose of determining the probable cost of production and operating profits in the manufacture of 20 million lbs./year acetylene at ——, Texas, using the Sachsse partial oxidation process."

The second paragraph should be a statement of the approach employed.

Example: "The entire plant is to be newly erected and employed for the sole purpose of producing acetylene throughout the year. Two bases of write-off have been considered: 1) The entire plant is to be amortized in five (5) years; and 2) The entire plant is to be amortized in ten (10) years.

"It has been assumed that the plant will be operated 330 days per year, 24 hours per day, at 100 percent of capacity."

The third paragraph should summarize the investment costs. In a comparative report several investment costs may have to be reported at this point. In that case, a tabular arrangement is advantageous:

Example: "It is estimated that a plant built for this production purpose will, at November, 1951, prices, necessitate an investment of

$2,600,000

This includes the price of the required oxygen plant as well as investment costs for necessary expansion of utilities and general office and shop facilities now existing at ——— (name of plant site)."

The fourth paragraph should summarize the production costs, stating the assumed price for the principal cost factors involved. This should include a breakdown according to five categories: Raw material costs, labor charges, utilities, capital charges, and miscellaneous cost items. If two prices have been assumed for a major cost factor (e.g., for the principal raw material or for electric power), the resultant second cost estimate may be stated in a similar manner in the following paragraph.

Example: "If the purchase price of methane is taken at 15 cents per Mcf and the electric power is charged at 0.7 cents per KWH, the following production costs may be expected:

	Case 1	Case 2
Raw materials	——	——
Labor	——	——
Utilities	——	——
Capital charges	——	——
Miscellaneous	——	——
Total Production Cost	——	——

"This evaluation credits byproduct water gas at its fuel value only."

The fifth paragraph should be a statement of the operating profits (if the market price of the product can be ascertained), or of the break-even market price for the product (if the established market price is not known). Two bases for operating profit are of interest: Annual return, percent of investment; and annual return, percent of sales.

Example: "At these production costs, the following net profit may be expected at a sales price of —— cents per pound product:

Annual Profit	Case 1	Case 2
Percent of investment	——	——
Percent of sales	——	——"

In any of the above paragraphs, reference to pertinent curves appearing in the appendix will add to the report's clarity.

The above section has had the purpose of presenting in concise manner the principal design bases and the conclusions reached. The non-technical reader should need to go no further than this point to derive full benefit from the preliminary cost report.

Technical Section

Following this stage, it becomes necessary to present the technical assumption and design data which underly the conclusions offered in the initial summarizing paragraphs. In this section, brevity is still desirable but must take second place to completeness. The technical section is subdivided into a number of sub-sections, each of which may consist of several paragraphs. Each sub-section should be clearly captioned.

Sub-Section 1 should briefly familiarize the reader with the product, its physical characteristics (except where these are commonly known), its principal intended uses, actual or potential, and the market situation and main production methods existing for it. In this section, a statement may be introduced which will explain the basis for selecting a particular plant design capacity.

Example: "Production and Main Uses of Acetylene"

"Production of acetylene in the United States in 1950 has been estimated at 671,000 tons (R-1). Practically this entire output is based on the conventional calcium carbide process. During the past few years, considerable progress has been made both in the United States and abroad toward the production of acetylene from gaseous hydrocarbons, and three basic processes are now available toward this end: Partial oxidation, regenerative pyrolytic cracking, and cracking in an electric discharge. At this writing, two plants based on the partial oxidation process are being erected at Texas City, Texas (by Monsanto Chemical Company, and Carbide and Carbon Chemicals Company, respectively). No commercial installations based on the other available cracking methods have so far been reported for the United States.

"Aside from its application for welding purposes, acetylene finds important uses as intermediate in the production of acrylonitrile, vinyl chloride, vinyl acetylene, vinyl acetate, tetrachloroethane, trichloroethylene, koresins, and a number of other chemicals. The proposed plant capacity of 20 million pounds per year has been selected to satisfy the needs of a proposed ——— plant at the same site which will use acetylene as intermediate. The acetylene will be produced in 98 percent purity as required by the consumer plant."

Sub-Section 2 should outline the process to be used, including a statement of yield in each operating step. The source of information should be stated in each case by reference to a bibliography at the end of the report. The underlying chemical reactions should be shown in this sub-section. In outlining the materials flow, reference should be made to the flow sheet which should be included in the appendix of the report.

In this connection, all major process assumptions (such as method of purification, if not known from the laboratory or from the literature) should be clearly stated and labeled as assumptions. If a basis for the assumptions can be given, it should be stated (e.g., by reference to some existing patent, or by comparison to a similar process). Otherwise, some such statement should be included, as: "In the absence of specific information, it has

been assumed that satisfactory sulfur removal can be achieved by the use of hypersorption equipment." Certain common assumptions, such as handling losses, need merely be stated. This subsection should be captioned on the left-hand side: "*Description of Process.*"

Sub-Section 3 should be captioned on the left-hand side: "*Equipment Requirements.*" This should be a discussion of major factors influencing the design of equipment (e.g., reaction time, temperature, materials of construction, filtration rates, etc.). In each case, the source of information should be given, or a statement should be included which will identify any assumption as such, and which will either justify the assumption or indicate that it has been made in the complete absence of proper data.

Sub-Section 3a follows sub-section 3 without a separate heading. It may be introduced by some statement such as: "The following major pieces of equipment will be required." The equipment will then be listed in the form of specifications.

Alternately, a wholly separate section may be provided for this purpose. This latter approach is to be preferred especially if the number of equipment items is large.

Each piece of equipment should be identified by a number on both the flow sheet and in the specifications. Several numbering systems are equally acceptable, but one type should be selected and adhered to in all reports. The numerals may classify the equipment either by type (e.g., pumps, reaction vessels, etc.) or by its place in the process scheme (e.g., feed storage, feed preparation, reaction stage, etc.).

If it is, for instance, decided to work according to the second scheme, the feed storage section might be assigned the Key Number 10. Equipment within this section may then be numbered consecutively 1001 to 1099.

In each case, the equipment numbers in the specifications must be the same as the equipment numbers assigned to the corresponding piece of equipment in the flow sheet.

For each piece of equipment, there shall be a statement of the purpose, number required, duty, type, major dimensions, operating conditions, construction materials, flow sheet reference, and similar pertinent information.

Examples illustrating typical specification forms to be followed are shown in Form 1 and Form 2.

Sub-Section 4, captioned "*Estimate of Investment*" should present a breakdown of the estimate. For preliminary evaluations of the type under discussion, it is generally sufficient to determine the first cost of equipment and buildings and to apply factors for piping, steel, foundation, electrical work, insulation, instrumentation, erection, etc. It should be emphasized, however, that this approach is only adequate for the purpose of obtaining a budget estimate, i.e., to provide a preliminary picture of the production costs. Contractors' bids or construction estimates will have to be estimated on the basis of an actual detail study of the piping, insulation, etc., requirements as set by the process design and plant layout.

Two fundamentally different approaches to "quickie" estimates are employed to good advantage. One of these is based on erected equipment cost, while the second is based on uninstalled equipment costs. The latter method has the advantage that it permits more rapid accumulation of equipment cost data, since manufacturers universally prefer to submit their quotations on an uninstalled basis. However, difficulties are encountered here in including the cost of field-erected equipment such as large storage tanks, refractory furnaces, etc. Correction factors must be applied to permit the inclusion of such equipment in a cost estimate based on uninstalled equipment costs.

With a knowledge of total uninstalled process equipment costs, the initial plant cost can be approximated, using suitable conversion factors. Best-known among these are the relations due to Lang.[1] According to this correlation, the total estimated plant cost will be:

3.10 × delivered equipment cost, for solids processes.
3.63 × delivered equipment cost, for solids-fluids processes.
4.74 × delivered equipment cost, for fluids processes.

Estimates based on installed equipment cost tend to be somewhat more accurate provided that adequate basic equipment information can be procured. Published information, based on this method, has been made available by Chilton.[2] To obtain erected plant cost, the method totals installed equipment prices and then adds the following factors:

Expressed as Percentages of Installed Process Equipment Cost:

Process Piping = 7-60 percent (depending on type of material handled)
Instrumentation = 2-15 percent (depending on degree of automatic operation)
Manufacturing Buildings = 0-100 percent (depending on extent of construction required)
Auxiliary Facilities = 0-100 percent (depending on extent of required additions to existing facilities)
Outside Lines = 0-25 percent (depending on building relationship)

Expressed as Percentages of Total Physical Cost

Engineering and Construction = 20-50 percent (depending on difficulty of design)
Contingencies = 10-50 percent (depending on degree of certainty in process design)
Size Factor = 0-35 percent (depending on plant size)

Still other methods of quick estimating, based on delivered equipment costs, assign separate experience factors to labor and materials costs involved in unloading equipment, erection, piping, steel work, foundation, electrical work, etc.

Whichever approach is chosen in the preparation of the estimate, the method should be clearly stated in Sub-Section 4 of the cost evaluation

FORM 1

1017, 1018	2 TANKS
Purpose	To store acetonyl acetone
Type	Vertical cylindrical vessel with conical top
Construction	Welded vessel, suitably mounted on concrete foundation
Capacity	13,000 gallons
Dimensions	10'—6" diameter x 20'—6" shell length
Design: Pressure	Atmospheric
Design: Temperature	100 °F.
Material of Construction	Carbon Steel
Code	NBFU
Flow Sheet Reference	10

FORM 2

3037	1 HEAT EXCHANGER
Purpose	To cool acetonyl acetone leaving stripping column 3012
Type	Shell-and-tube heat exchanger, floating head, removable tube bundle
Construction	Welded vessel, suitably mounted in horizontal position
Duty	1.35 million Btu/hr
Conditions	Tubes: Water from 80 to 110 °F. Shell: Acetonyl Acetone from 180 to 100 °F.
Surface	280 sq. ft.
Design Pressure	Tubes: 60 psig Shell: 30 psig
Material of Construction	Tubes: Admiralty metal Shell: Carbon steel
Code	API-ASME
Flow Sheet Reference	30A

FORM 3

Item No.	Description	No. Required	Cost per Unit	Total Cost
	Total Equipment Cost ((un-) installed basis)			

Production Cost Estimate

Product _____ Rated Capacity _____
Period of Operation _____ Total Production _____
First Investment _____ Per Cent of Rated Capacity _____

	Total Amount (State Units)	Unit Price—$	Total Cost—$	Cost per Unit Product—$
A. RAW MATERIALS (incl. catalysts and chemicals) 1.				
2.				
3.				
4.				
5.				
6.				
A. Total				
B. UTILITIES 1. Steam				
2. Process Water				
3. Service Water				
4. Fuel ( )				
5. Electricity				
6.				
B. Total				
C. LABOR 1. Direct Supervision and Clerical				
2. Direct Operating Labor				
3. Packing and Shipping Labor				
4. Maintenance Labor				
5. Plant Overhead (_____% of Items C2, C3, plus C4)				
C. Total				

report. The preferred method is to prepare a tabulation of equipment costs, according to Form 3.

The tabulation is followed by a list of the factors used to convert from equipment costs to full plant cost. If a detailed estimate has been prepared for a more careful cost study, a partial breakdown of this estimate should be presented at this point.

Sub-Section 5, captioned "*Raw Materials, Labor, and Utilities*," should list raw materials usage on any suitable basis, but preferably per unit of product. It should also state labor requirements and assumed labor charges. A breakdown should be given of expected operating labor requirements and costs for the various unit operations. A similar breakdown for utilities requirements is shown to advantage at this point.

This section should also contain a statement of annual costs assumed or estimated for the laboratory, for supervisory purposes, etc.

Sub-Section 6, captioned "*Miscellaneous Assumptions*" should indicate secondary design assumptions of importance which have not been stated elsewhere in the report. This includes heat transfer factors, plate efficiencies, method employed for estimating number of plates, etc.

It should be noted that the inclusion of this Sub-Section 6 is not universally favored in preliminary cost evaluation reports. It may be argued that this information goes into engineering detail which need not be made part of the generally circulating report. In any case, it is essential that this information be retained in the records, however. Where it is not included in the report proper, it should be carefully retained in generally accessible files for review in case of dispute.

Sub-Section 7, Captioned "*Bibliography*," should be typed on a separate page even if the preceding sections have been arranged in a continuous text. All cited references should be listed here. The listing must be referred to in the text of the report by the number shown in the bibliography. Arrangement may be either alphabetical or in the order of the reference's appearance in the body of the report.

Sub-Section 8 should be a tabular presentation of the "Production Cost Estimate" and "Profit Estimate." Tabulations may be prepared on any suitable basis. Useful, in this connection, is the preparation of printed tabular forms which may be employed for all cost studies. Typical are the forms accompanying this article and the forms published by the U. S. Bureau of Mines.[3]

In a great many chemical processes, utilities requirements are a relatively minor factor in the production cost picture. In such cases, a preliminary study will permit the use of typical unit prices. If utilities prices are available from actual on-site plant data, these figures are to be preferred. Otherwise a suitable figure may generally be selected from the ranges (applicable in early 1952) shown in Table 1.

TABLE 1

Live steam	$ 0.35 to $ 0.85 per M lbs.
Exhaust steam (low pressure)	$0.20 to $0.45 per M lbs.
Service Water	$0.01 to $0.04 per M gals.
Natural Gas	$0.15 to $0.65 per MM Btu.
Coal	$2.00 to $15.00 per ton
Fuel Oil	$0.03 to $0.14 per gallon
Electricity	$0.006 to $0.20 per kwh
Process Water	$0.03 to $0.17 per M gals.

Operating labor rates have risen rapidly during recent years and up-to-date figures can best be obtained from publications by the Bureau of Labor Statistics. Typical labor rates in industrial areas in early 1952 vary from $1.30 to $2 per man-hour, depending on locality and on the degree of skill required. In determining proper scheduling of operations, efforts should be made to keep overtime at a minimum. Where the specific needs of the process make a shift-week in excess of 40 working hours necessary, the cost evaluation must make allowance for the premium pay required.

Plant overhead varies widely, depending on the method of bookkeeping and the organizational relationships involved. As shown in the tabular estimate form, it is meant to include employee benefit plans and group insurance, vacations, social security payments, hospital and first aid expenses, workmen's compensation insurance, sanitation and janitorial service not directly related to the processing steps, travel and personnel transportation, as well as administrative and general office overhead. These factors add up to 40-100 percent of operating, packaging, and maintenance labor. Most common range is 60-80 percent.

Certain fixed production costs, shown in the estimate form, are based on percentages of the first investment cost. Largest single factor are the charges due to depreciation and amortization which are set by the rate at which the plant is to be written off. For tax computation purposes, tables of permissible depreciation rates are published by the U. S. Bureau of Internal Revenue. For internal bookkeep-

ing purposes, depreciation rates are set by company policy as well as by industry practice. For the purpose of preliminary cost estimates, depreciation rates of 10 percent on equipment and 5 percent on buildings are frequently employed in the chemical process industries.

Insurance rates against losses by fire, explosion, tornado, etc., vary in accordance with the degree in which adequate safety measures have been taken. Actual insurance rates can only be determined by quotation from the underwriter. For the purpose of preliminary cost estimates, an insurance rate of 1 percent per year on capital investment is recommended.

Local, county, and state taxes vary with locale. An average figure of 1-2 percent per year on capital investment will serve in the preparation of preliminary cost estimates.

Interest is not universally accepted as a proper operating expense. Considerable argument may be advanced both in favor and opposition to this practice, but a study of this question would lead too far afield at this point. If interest is to be charged, however, its rate will vary depending on a great many factors influencing the market. For the purpose of preliminary cost estimates, 2.5-4 percent annually on investment and operating capital represents a fair average.

Charges for patents, licenses, and royalties, if any, are negotiated for each process. Such charges tend to represent 0.25 to 0.75 percent of the total cost of the finished product.

In the chemical process industries, 1 to 7 percent of net profits are generally set aside for research expenditure. The amount actually involved is wholly a question of company policy and no generalization will be attempted at this point.

Miscellaneous costs include a) maintenance materials and operating supplies which, together, may be taken at 2-3 percent of total investment cost, unless there are exceptional considerations; and b) packaging materials.

Sub-Section 9 should contain all required flow sheets, layout drawings (if any), and required curves. If these drawings total more than eight or nine items, an index will prove useful at the beginning of this sub-section.

Wherever possible, flow sheets should indicate a complete materials balance either on the drawing itself or on a separate sheet on which the streams are properly identified.

Production Cost Estimate (Page 2)

	Total Amount (State Units)	Unit Price—$	Total Cost—$	Cost per Unit Product—$
D. FIXED COSTS				
1. Depreciation and Amort'n (_____% per year)				
2. Insurance (_____% per year)				
3. Tax (_____% per year)				
4. Interest (_____% per year of investment plus operating capital)				
5. Patents, Licenses, Royalties				
6. Research and Development				
D. Total				
E. OTHER COSTS				
1. Maintenance Materials				
2. Operating Supplies				
3. Packaging Materials				
4.				
5.				
E. Total				
TOTAL OPERATING COSTS				
F. BY-PRODUCT CREDIT				
1.				
2.				
3.				
4.				
F. Total				

TOTAL PRODUCTION COSTS (Item E minus Item F)

Total Cost $_____ per _____

Cost per Unit Product $_____ per _____

Profit Estimate

Product_____

Period of Operation_____

Investment_____

	$ per Unit Product	$ per Total Product
A. Income from Sales of Principal Products (Not Including By-Products)		
1.		
2.		
A. Total		
B. Expenses:		
1. Plant Production Costs		
2. Freight		
3. Sales and Advertising Costs		
4. Miscellaneous Overhead		
5.		
B. Total		

C. Net Profit (before Income Tax) — $
(Item A minus Item B)
1. Profit (% of Sales) _____
2. Profit (% of Investment) _____

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[1] Lang, H. J., Chem. Eng. **55**, No. 6, pp. 112-113 (June 1948).

[2] Chilton, C. H., Chem. Eng. **56**, No. 6, pp. 97-106 (June 1949).

[3] Van Noy, C. W., et al., U. S. Bureau of Mines Report of Investigations 4534 (November 1949).

* * *

The Solution of Multicomponent Phase Equilibria Problems

New techniques developed for simplifying calculations of bubble points, dew points and flash vaporization

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ONE of the more important and frequently occurring technical problems in petroleum processing deals with the estimation of the relative amounts of vapor phase and liquid phase produced by a given mixture of hydrocarbons when subjected to fixed pressure and temperature conditions. This problem may be solved by two methods, the theoretical and the empirical, whose respective applicability generally depends on the molecular weight and concentration of hydrocarbons in the system. The theoretical method is used primarily for those systems predominating in the light hydrocarbons, methane through the hexanes, while the empirical method is used for systems of such complexity that they cannot be defined in terms of individual hydrocarbons. The empirical method employs charts and nomographs which have been plotted from experimental equilibrium flashes and the more readily determined true boiling and ASTM distillations. Their accuracy in predicting the vapor/liquid ratio under any given circumstance depends largely on the accuracy of the initial data and the skill of the person doing the correlating. Several such charts have been published.[1,2,3,4] This article will be concerned primarily with the theoretical method, whose mathematical solution is based on two physical laws, viz., Henry's Law and the material balance.

The mathematics involved in multicomponent phase equilibrium calculations are basically simple, and nothing higher than algebra is ordinarily required. The principal phase equilibrium equation—Equation (1)—used in this method is developed in Table 1. It has appeared in many forms in prior literature, and is developed here primarily as a reference for this discussion.

HERE IS a new treatment of multicomponent phase equilibrium problems which promotes real understanding of the complicated mathematics upon which all practical methods are based. Through this basic understanding new techniques are developed for simplifying the calculation of bubble points, dew points, and flash vaporization. A very simple graphical method is given for estimating flash vaporization and reducing the amount of trials required in the application of the more precise methods. Also included is a review of the basic mathematics and previous calculation methods.

NOMENCLATURE

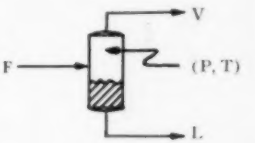
- F = mols of total feed charged.
- V = mols of total vapor flashed.
- L = mols of total liquid remaining after the flash.
- P = system pressure, psia.
- T = system temperature, ° F.
- f_n = mols of nth component in feed.
- v_n = mols of nth component in vapor.
- l_n = mols of nth component in liquid.
- K_n = equilibrium constant of nth component at P and T.
- C = mol ratio, V/L. (This ratio may be considered as the equilibrium constant of the system itself.)

TABLE 1

Development of Multicomponent Phase Equilibrium Equation

FLASH EQUILIBRIUM SYSTEM:

$$F = f_1 + f_2 \ldots + f_n.$$
$$V = v_1 + v_2 \ldots + v_n.$$
$$L = l_1 + l_2 \ldots + l_n.$$



HENRY'S LAW:

$$K_n = (v_n/V)/(l_n/L).$$

OVER-ALL MATERIAL BALANCE:

Assume $F = 1.0$ mol.

$$F = 1.0 = V + L.$$

nth COMPONENT MATERIAL BALANCE:

$$f_n = v_n + l_n.$$

EQUATION DEVELOPMENT:

$$CK_n = v_n/l_n.$$
$$L = 1/(1 + C).$$
$$f_n/l_n = v_n/l_n + l_n/l_n.$$
$$f_n/l_n = CK_n + 1.$$
$$l_n = f_n/(1 + CK_n).$$
$$L = \sum l_n$$

THEREFORE:

$$1/(1 + C) = \sum f_n/(1 + CK_n). \quad (1)$$

The relation of Equation (1) in Table 1 to the classical algebraic forms of equations may be seen when Equation (1) has been expanded and simplified. For a three-component system as an example, this simplification to a classical algebraic form may be done as follows, starting with:

$$1/(1 + C) = f_1/(1 + CK_1) + f_2/(1 + CK_2) + f_3/(1 + CK_3) \quad (2)$$

Since the feed composition (f_1, f_2, f_3) and equilibrium constants (K_1, K_2, K_3) are known values, it is seen that this equation contains only one unknown, viz., C, or the vapor/liquid ratio. This unknown ratio is readily isolated by cross-multiplication, followed by re-

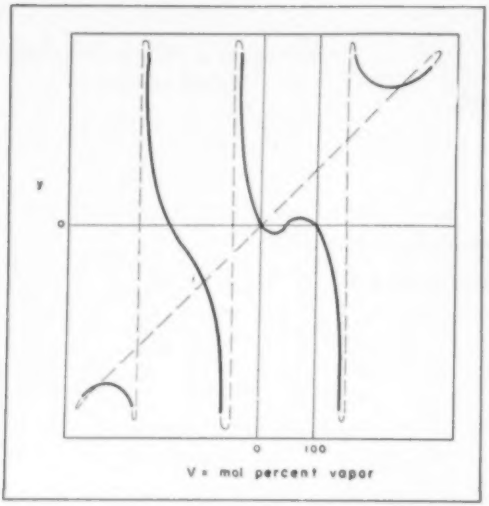


Figure 1 (above). Typical Wraparound Plot of the Flash Equilibrium Equation at Constant Temperature and Pressure.

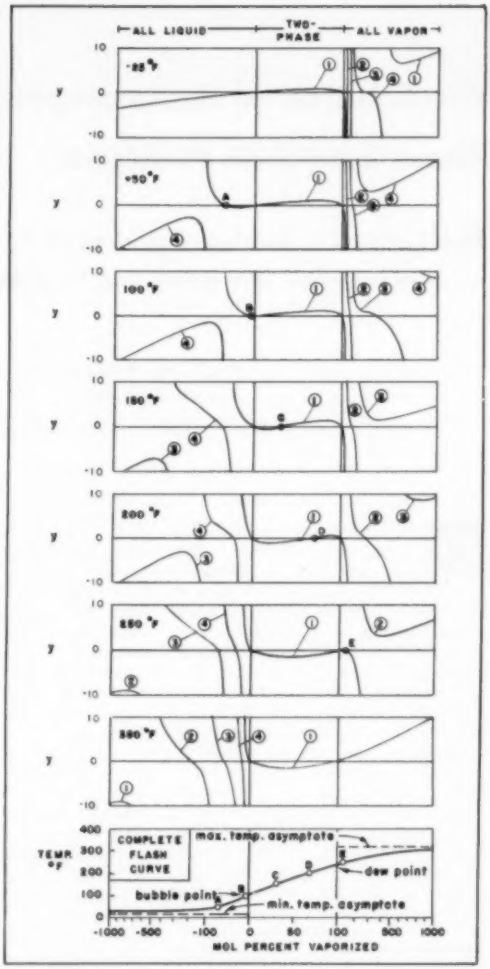


Figure 2 (right). Development of Complete Flash Curve from Constant Temperature - Constant Pressure Plots of the Flash Equilibrium Equation.

arrangement to an equation of descending order in C, in the classical form:

$$y = aC^3 + bC + c = 0 \qquad (3)$$

where

y = value of the equation for any given value of C.

C = mols of total vapor phase divided by mols of total liquid phase at equilibrium.

$a = K_1K_2K_3 - f_1K_2K_3 - f_2K_1K_3 - f_3K_1K_2$

$b = f_1K_1K_2 + f_2K_1K_3 + f_1K_1K_3 + f_2K_2K_3 + f_3K_2K_3 + f_1K_1 + f_1K_2 + f_2K_3 - K_1 - K_2 - K_3$

$c = f_1K_1 + f_2K_2 + f_3K_3 - 1.$

Any value of C which makes $y = 0$ is a solution to Equation (3).

Thus, a three-component system reduces to a quadratic equation whose coefficients have a total of twenty terms. A four-component system will reduce to a cubic equation whose coefficients have more than a hundred terms, and a ten-component system will "reduce" to a ninth-power equation in C,

$$y = aC^9 + bC^8 + cC^7 + dC^6 + eC^5 + fC^4 + gC^3 + hC^2 + iC + j = 0$$

whose coefficients will be very lengthy, having a total of more than 20,000 terms. This rapid increase in length of the coefficients with increase in complexity of the hydrocarbon system indicates why the brief form—Equation (1)—of the theoretical equation is used by petroleum engineers rather than the reduced classical form.

However, it may be noted that this development of the brief general Equation (1) into the classical form shows that a system of n components will produce a classical-form equation of n-1 power in C. (As a special case, it is possible that the K-value of one of the components would be unity, producing a simpler equation of n-2 power in C.). A two-component system thus produces a linear equation, and the solving of this type of equation dates back to ancient Egyptian times. A three-component system produces a quadratic equation as shown above, whose solution dates back to the Hindus and Arabs. Four- and five-component systems produce cubic and quartic equations, respectively, whose rather difficult but exact solutions were discovered by Italian mathematicians in the sixteenth century. Mathematicians then generally presumed that precise solutions of higher-powered equations would come in time, but in 1813 Ruffini proved that equations of higher order than the quartic could not be solved exactly with any finite number of algebraic operations and roots. Sir Isaac Newton and other mathematicians proposed methods which permit of an orderly approach to the approximate solution of higher powered equations, but at best the final solutions to these higher order equations cannot be determined exactly, and the methods are fairly tedious. McReynold's method[5] appears to involve either the Method of Chords or Newton's Method of Tangents, and it offers a decrease in the labor required to solve multicomponent phase equilibrium problems. Recently, P. M. Reilly[6] has suggested a novel method of "closing in" on the correct answer

by a procedure based on the sum of infinite geometric series.

However, Equation (1) or its equivalent is most often used because of its simplicity. Trial-and-error with graphical interpolation is generally employed in its solution because most petroleum processing systems have four or more components. This equation's limits, asymptotes, and other characteristics may be determined readily when it is rearranged to the following form:

$$y = f_1/(1 + CK_1) + f_2/(1 + CK_2) + \cdots + f_n/(1 + CK_n) - 1/(1 + C) = 0 \qquad (1a)$$

As pointed out previously, any value of C which makes $y = 0$ is a solution to the equation. The immediately following discussion is primarily a presentation of the properties of this equation.

At the bubble point, by definition the vapor phase is incipient, or in other words, C=V/L=zero. Likewise, at the dew point, the system has no liquid phase, so C = infinity. Inspection of Equation (1a) indicates that when C is either zero or infinite, $y = 0$, or in other words, Equation (1a) has two fixed mathematical solutions which indicate dew and bubble points regardless of whether or not the system is at its dew or bubble points. Therefore, C=0 and C=infinity offer two spurious solutions to Equation (1a) and both are eliminated when Equations (1) or (1a) are reduced to the classical form such as Equation (3). Because of these spurious solutions, Equations (1) and (1a) are difficult to apply in determining the dew and the bubble points.

Equation (1a) has a total of n + 1 possible solutions, and the two fixed solutions indicate that n-1 solutions are yet unknown. Of these remaining n-1 solutions, all will be negative in sign and physically meaningless if the system is either colder than the bubble point or hotter than the dew point. But if the system has two phases, one and only one of the solutions to Equation (1a) will be positive in sign, and it is this one positive solution which the process engineer must discover.

When Equation (1a) is plotted as y versus Mol Percent V for a given system, the complete curve will resemble the example in Figure 1. This curve may be considered as a continuous wrap-around if it is assumed that a curve does not break in passing from plus infinity to minus infinity or vice versa. The curve is thus guided around from finite values to infinity by means of vertical asymptotes, which are determined by setting $C = -1/K_n$. (If it be assumed that $C = -1/K_1$ in Equation (1a), then $CK_1 = -1$, and therefore $f_1/(1 + CK_1) =$ infinity. Thus, $C = -1/K_1$ is the asymptote for component number one, and in like manner $C = -1/K_n$ is the asymptote for component n. Thus, n asymptotes of Equation (1a) may be determined.) Also, in the upper left and lower right hand corners of Figure 1, the curve passes to infinity along the guide line y=V, which guide line is not an asymptote. The process engineer can for a first trial on a problem choose *any* finite value for V, either negative or positive, and can calculate by means of Equation (1a) the corresponding value of y. He can always get an answer, but it will rarely be the desired solution. For example, with a system of say six components, Equation (1a) would plot as a wrap-around curve crossing the abscissa seven times. One crossing would occur at V=0 percent, another at V=100 percent for the two fixed solutions, and if one component happened to have a K-value of unity, a third crossing would occur at V=infinity. Of the remaining crossings, one and only one would occur between V=0 percent and V=100 percent if the system was composed of two phases, vapor and liquid, and the determination of this latter crossing point is the desired solution to the problem. It may be noted that this one particular solution can occur only between the asymptotes of the heaviest and the lightest hydrocarbons. If this particular solution occurs at a negative value of V, the system is cooler than its bubble point. If it occurs at a value of V greater than 100 percent, the system is composed of superheated vapor. If it coincides with either V=0 percent or V=100 percent, the system is at its bubble point or dew point, respectively. As has been pointed out previously, this coincidence is difficult to interpret by Equation (1a), and a much simpler method of determining the bubble and dew points will be pre-

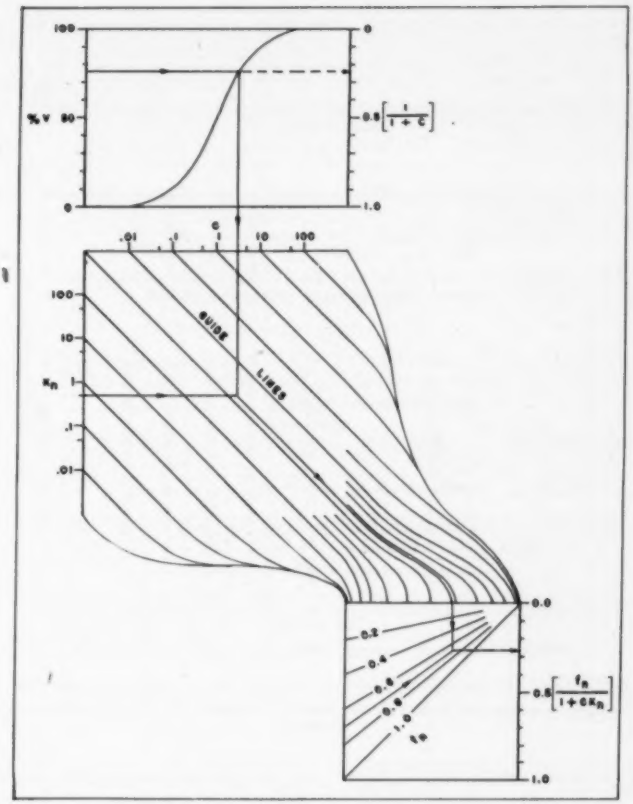


Figure 3. Alignment Chart for the Flash Equilibrium Equation.

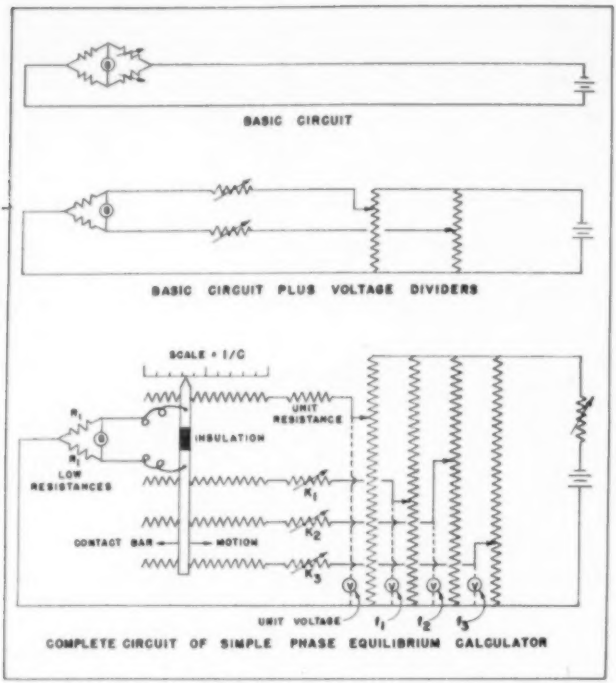


Figure 4. Development of an Electrical Analogue Calculator for the Flash Equilibrium Equation.

sented later in this article.

For a graphical illustration of the above discussion, the following hydrocarbon system was examined:

	f
C_2	.25
C_3	.25
C_4	.25
C_5	.25
	1.00

System Pressure = 250 psia.

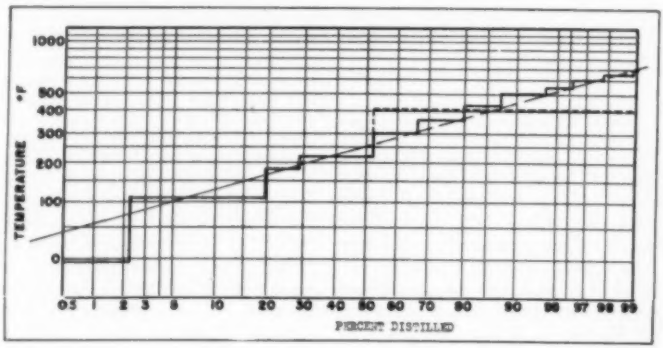
Plots of Equation (1a) as y vs. mol percent V at system pressure and several temperatures were made, covering the system as it was changed from a liquid through the two phase region to a super-heated vapor. The results are shown in Figure 2. The y scale in this figure is linear, as is the V scale between 0 and 100 percent, but the V scale on either side of 0 and 100 has been made parabolic in order to compress the diagram into a small space while yet emphasizing the 0 to 100 range. Curve 1 falls between the asymptotes of C_2 and C_5 (the lightest and heaviest components of the system) and is the only curve which can have any physical meaning; two of its intersections with $y=0$ are spurious solutions, while its third intersection is the desired solution if it falls between $V=0$ percent and $V=100$ percent. Curve 2 falls between the asymptotes of C_5 and C_4; Curve 3 between C_4 and C_3; and Curve 4 between C_3 and C_2. Each temperature plot shows the single physically important solution by a circle (A, B, C, D, and E), and these circles are shown again in the final plot, where Temperature is plotted vs. Mol Percent V in the customary flash distillation form. Two more asymptotes of Equation (1a) appear in this latter diagram; these are flash curve temperature limits as follows: the flash curve is asymptotic at its lowest temperature to that temperature at which the lightest component has a K of unity, and at its highest temperature to that temperature at which the heaviest component has a K of unity. These two asymptotes are at the effective boiling points of the lightest and heaviest components of the system at system pressure, and will be employed in a later section describing a brief method of making a first estimate of a complete flash curve.

K-values indicate tendencies toward liquid or vapor states. A component whose K-value is less than unity under system conditions tends to remain or become liquefied; a component whose K-value is unity is at its effective boiling point; and a component whose K-value is greater than unity tends to remain or become vaporized. These well-known statements are mentioned here in order that it may be emphasized that: 1) *all* the components in a system need not be at or above their effective boiling points for the system as a whole to be completely vaporized, and 2) conversely, *all* the components need not be at or below their effective boiling points for the entire system to be liquefied. Effect No. 1 is commonly called the "carrying effect of light ends," while effect No. 2 is not so widely known. It might be termed the "deadening effect of heavy ends." These two effects are not readily seen to be implicit in Equation (1a), but may be borne out by calculations made near the dew and bubble points of a given system.

Nomographical Solutions of the Phase Equilibrium Equation

Equation (1) and its modifications have been the subject of several articles wherein nomographical or alignment type diagrams have been presented to assist in its solution.[7,8,9] These gener-

Figure 5. Trial Plot for Determining the Complete TBP of an Unstabilized Natural Gasoline.



ally have been of reasonable accuracy and tend to reduce mechanical errors in calculation. A simple alignment chart of this equation is presented in Figure 3. Lines with direction arrows indicate the method of use. A value of C or of mol percent vaporized is assumed, and each component in turn is considered on the chart, at the same C but at their respective values of K and f. Each component then has a value of $f_n/(1 + CK_n)$ derived from the alignment chart, and all of these are totalled to see if their sum equals $1/(1 + C)$ which is determined from the assumed C value. If not, another value of C is assumed and another trial is made. A plot of assumed vs. calculated values of $1/(1 + C)$ assists in arriving at equality and a solution.

Figure 3 is presented primarily to indicate the difficulty of arriving at the correct solution in only one or two trials. Obviously, certain combinations of K_n and C affect the calculated value of $1/(1 + C)$ very much more than others, and the value of $1/(1 + C)$ changes very slowly are rapidly depending on the range of C values assumed. The human mind tends to think in linear terms and several components applied to a pattern such as Figure 3 produce results which are practically impossible to visualize for mental extrapolation purposes. Furthermore, examination of a given problem gives few hints as to what the first trial value of C should be, especially to the engineer who handles such problems infrequently. A general rule is to assume that the split between vapor and liquid will occur near that component having a K-value nearest unity,[10] but this is usually only a gross approximation, since many hydrocarbon mixtures predominate in either heavy or light materials.

Thus, while nomographical charts give little help in deciding on a first trial value of C or V, they are useful for obtaining reasonably accurate solutions to problems with a saving in time and in computational error.

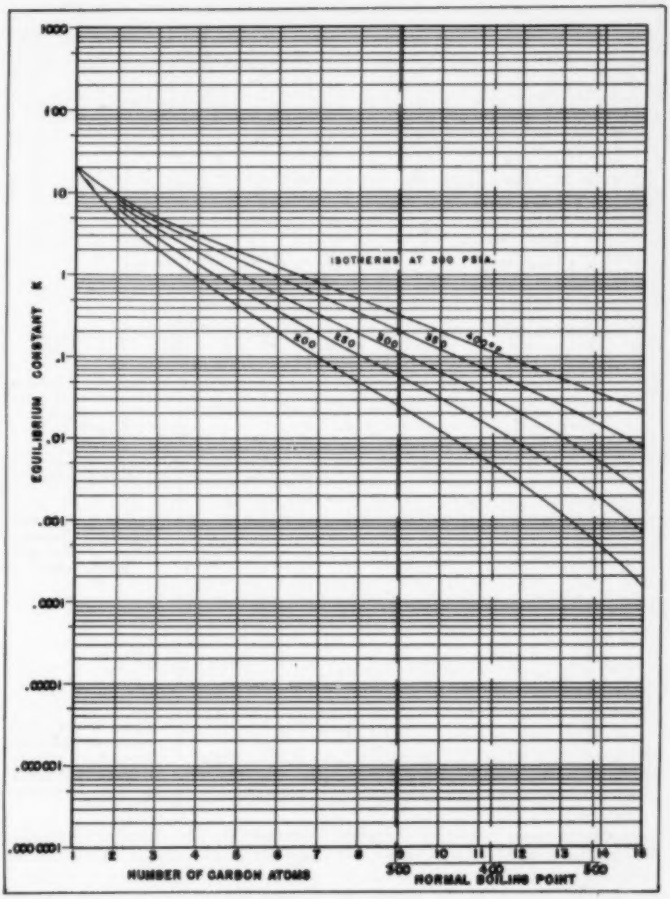


Figure 6. Chart for Estimating the Equilibrium Constants of High-Boiling Hydrocarbons.

Electrical Analogue Computers

The basic phase equilibrium equation is similar in form to several relationships governing other natural phenomena. The laws of the flow of heat, flow of fluids, and operation of levers are examples, but the most useful similarity is found in the well-known law of flow of electric currents, $I = E/R$ (amperes equal volts divided by resistance). For practical application of this law to phase equilibrium problems, the phase equation may be placed in the form:

$$1/(1 + 1/C) = \sum f_n/(K_n + 1/C) \quad (4)$$

in order to isolate the single unknown, C. Then the numerators of this equation may be considered as voltage E, and the denominators can be made up of resistances which add to become R. By connecting two such circuits in electrical opposition and properly adjusting E and R in both circuits to balance as indicated by no current flow in a galvanometer tied into the two circuits by a Wheatstone bridge arrangement, the variable resistance in R which corresponds to C can be found. One of the two opposing circuits can be built up of many parallel circuits, one for each component in the hydrocarbon system. The development of such a completed "calculator" is shown in Figure 4 in three steps, starting with the Wheatstone bridge, then adding a voltage divider, and finally expanding the basic form to fit the phase equilibrium equation. The calculator shown would handle only systems involving three components, but its expansion to any desired number of components could be done quite easily.

In operating such a calculator, the mol percents of the components in the feed are placed in the machine as voltages adjusted by the voltage dividers. Then K-values are placed in as resistances, and lastly the contact bar is moved over the parallel resistances until the galvanometer reads zero. The value C may then be read off the scale.

This type of calculator (analogue) gives an approximate answer, as does a slide rule, for example. It has certain practical limitations which will be recognized by any electrical engineer. For example, the resistances corresponding to K-values are not very

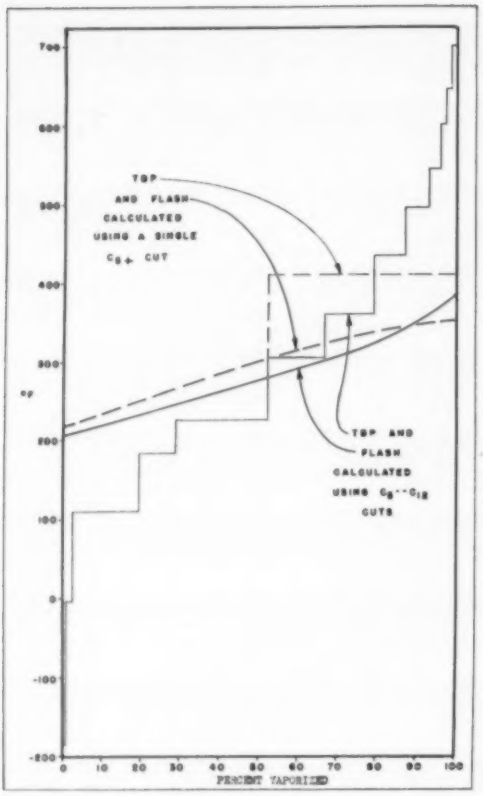


Figure 7 (left). Unstabilized Natural Gasoline: Flash Curves Calculated by Two Procedures.

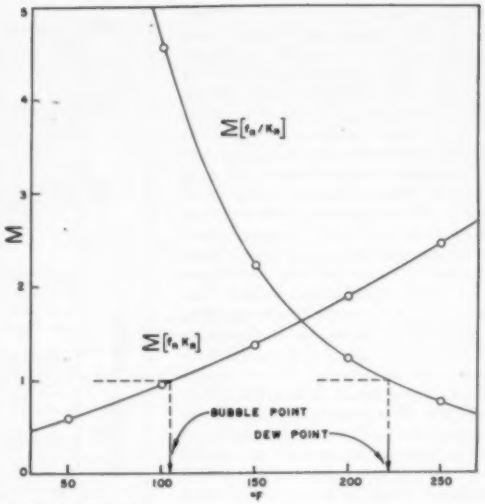


Figure 8 (above). Graphical Determination of Dew and Bubble Points.

accurate near zero ohms, yet the high-boiling hydrocarbons with very low K-values may have pronounced effects on the equilibrium of the system. At these low K-values, also, the resistances at the point of contact of the contact bar with the parallel resistances, or the relatively small balancing resistances R_1, may introduce unknown but important errors.

Several phase equilibrium calculators are on the market, with prices around the level of $25,000. Phillips Petroleum Company, The Texas Company, Northwestern University, and International Business Machines have developed such instruments, which are of course more complex than the one sketched in Figure 4.

Basically, all of these instruments obtain answers by trial-and-error, and their single advantage is a time saving on the order of 30 or 40 to 1.

Accuracy of Phase Equilibrium Calculations

The basic equation—Equation (1)—depends on Henry's Law, and this law implies that any given K-value is a constant which must be experimentally determined. The usual experimental method is as follows: in the laboratory, a given hydrocarbon system is placed under given pressure and temperature conditions and agitated until it is at equilibrium, as indicated by no further change in volume. A portion of both phases, gas and liquid, is removed and analyzed separately in True Boiling equipment such as the Podbielniak Hyd-Robot still, and the mol percent of a given component in the vapor divided by the mol percent of that same component in the liquid is the K-value for that component at those pressure and temperature conditions.

Unfortunately, these K-values have been found to vary with the composition of the system. More than that, they are scarcely reproducible in duplicate runs on the same system with the same TBP equipment and operator. For example, Katz and Hachmuth[11] discarded 44 percent of their data on a crude oil-natural gas system because that portion was assumed to exceed experimental accuracy. Some engineers have felt that since K-values seem to vary between systems, the best practice is to obtain direct experimental K-values on the particular system being studied, but such data is actually of questionable worth. For example, a careful equilibrium determination on a crude oil-natural gas system similar to Katz' system produced results which compare with his data as follows:

	Author	Katz
C_1	2.33	3.13
C_2	0.76	0.73
C_3	0.371	0.335
C_4	0.174	0.145
C_5	0.096	0.063
C_6+	0.0183*	0.019**

* Mol. Wt. 119. ** Heptanes.
K values at 1450 psia, 70° F.

The discrepancies here indicate the probable weakness of any single determination. It is obvious that an error in just one of the twelve mol percents required to define six K-values will cause at least two K-values to be in error, and often will affect the accuracy of three or more.

Mercaptans[12] and aromatics form constant boiling mixtures with other hydrocarbons, which might influence the flash curves of such mixtures in a manner unpredictable from usual K-values or empirical flash curve estimations.

These comments regarding the accuracy of the basic K-value data point to the absurdity of carrying phase equilibrium calculations to any greater length than three or four numbers. That is, a calculation showing 35.4569 percent vapor in a particular system is little more accurate than one showing 35.5 percent.

Engineers usually assume, in the

absence of a TBP distillation of heavy end material, that a C_6+ or C_8+ fraction in a light hydrocarbon system will exhibit the K-value effect of the next higher-boiling hydrocarbon or perhaps the second higher-boiling hydrocarbon. Thus, C_5+ may be arbitrarily assigned the K-value of C_6 or of C_7, depending on the engineer and any data he may have regarding the molecular weight or specific gravity of the fraction. The use of a blanket K-value for the entire heavy end material will lead to an erroneous flash curve, as can be shown by comparable calculations made on a given system, with one calculation using a C_5+ blanket K-value based on specific gravity, and the other using C_5 and higher boiling hydrocarbons whose concentrations are obtained from an estimated TBP plot on probability paper. The system to be used for the illustration is a raw or unstabilized natural gasoline whose TBP analysis by the two procedures is as follows:

	Mol Percent	
	A	B
C_1	0.03	0.03
C_2	2.27	2.27
C_3	17.29	17.29
iC_4	9.38	9.38
C_4	23.33	23.33
C_5	14.70	47.70 (0.675 sp.gr.)
C_6	12.50	
C_7	7.70	
C_8	6.30	
C_9	2.70	
C_{10}	1.50	
C_{11}	1.20	
C_{12}	1.10	
	100.00	100.00

System pressure = 200 psia.

The B data are from a standard low-temperature fractional analysis. The A data are determined by assuming that hydrocarbons as heavy as C_{12} are in the C_5+. This is a reasonable assumption for most natural gasolines. Since these C_5 to C_{12} hydrocarbons usually come from natural gas flashed from one to three field tanks, it can readily be assumed that they are present in approximately a probability distribution. Thus, probability paper may be employed in estimating the analysis of the C_5+ fraction, as is done in Figure 5, where percentage distilled drawn linearly on a probability distribution is plotted versus the reciprocal of the absolute temperature. Trial-and-error to make the analysis fit the actual C_5+ specific gravity is necessary, and then a diagram such as Figure 6 is used to estimate the K-values of the high-boiling hydrocarbons. Figure 6 uses Poettmann & Mayland's K-values[13] for this extrapolation. From these approximations, a reasonable composition and set of K-values for the C_5+ is obtained, and complete flash curves for both A and B are then calculated. Figure 7 shows both curves, and indicates that the use of a blanket K-value for the C_5+ fraction can cause an error in the calculation of the percent vaporized of as much as 15 percent of the gasoline.

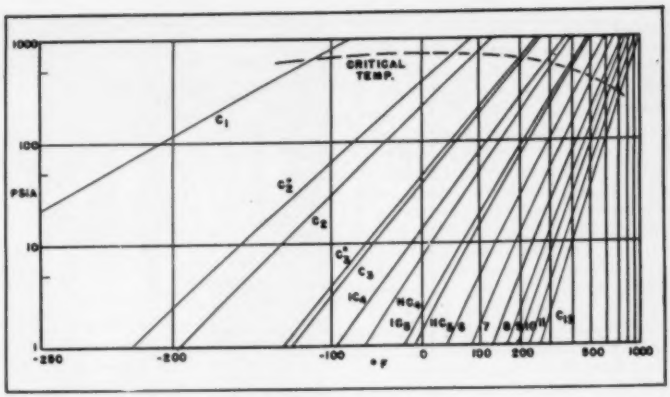


Figure 9. Cox Vapor Pressure Chart.

The usual practice of using blanket K-values is therefore open to serious error, and should be applied only when the fraction in question is known to have a relatively narrow boiling range, or is present as only a minor constituent.

Determination of Dew and Bubble Points

As has been pointed out previously,[14] the dew point is that temperature at which $\sum (f_n/K_n) = 1.0$, and the bubble point is that temperature at which $\sum (f_n K_n) = 1.0$. The dew and bubble point temperatures may be most easily determined graphically as indicated in the following example. K-values are from Edmister.[15]

Example 1.

System Pressure 250 psia

	f	K @ 50°	K @ 100°	K @ 150°	K @ 200°	K @ 250°
C_2	.25	1.825	2.720	3.60	4.56	5.50
C_3	.25	.428	.820	1.30	1.90	2.59
C_4	.25	.105	.253	.480	.800	1.23
C_5	.25	.026	.079	.174	.340	.58
	1.00					
$\Sigma(f_n/K_n)$		12.70	4.55	2.22	1.234	0.776
$\Sigma(f_n K_n)$		.596	.969	1.389	1.900	2.475

The summations are plotted versus their respective temperatures, as in Figure 8, from which the dew and bubble points are obtained by interpolation.

The range of temperatures to assume for the above table of K-values should be limited to approximately the boiling points of the lightest and heaviest hydrocarbons under system pressure. These boiling points may be read from Figure 9.

Procedure for Solving Flash Equilibrium Problems

The following step-by-step procedure may be used with a minimum of trial-and-error to solve a flash equilibrium problem. It has one outstanding advantage for those petroleum engineers who handle such problems infrequently, in that it requires only two things for a reasonably close estimate of the first trial value of V (or C) for Equation (1), namely a TBP plot of the system at system pressure, and a straight-forward determination of the dew and bubble points of the system at system pressure. These items suffice for a first approximation of the complete flash curve, which is often accurate enough for quick estimates of the V/L split at any given temperature. However, the added application of Equation (1) gives greater accuracy when that is required.

1) Determine both the dew and bubble points at system pressure, as in Example 1 and Figure 8.
2) Plot the TBP (temperature versus mol percent vaporized) at system pressure.
3) Mark the dew and bubble points on the TBP plot, as in Figure 10.
4) On the TBP plot, extend the boiling points of the lowest and the highest boiling components to form temperature-limiting asymptotes as in Figure 10.
5) As in Figure 10, draw a smooth

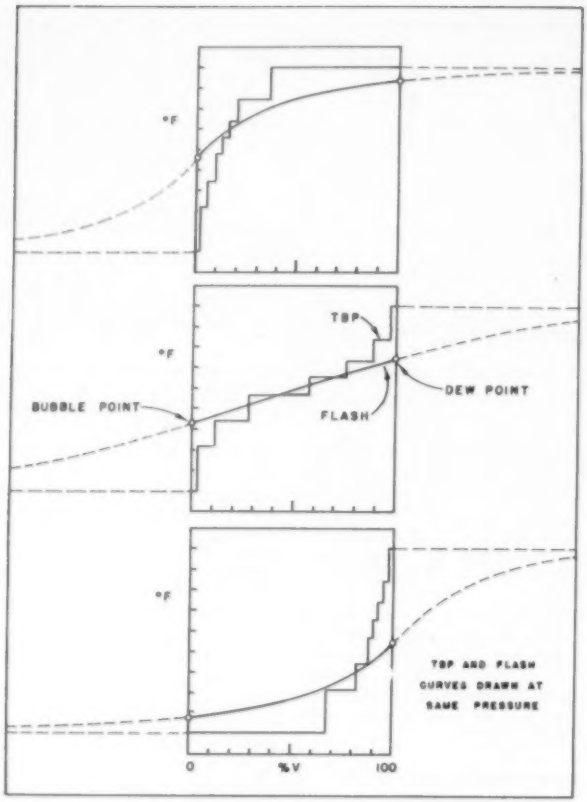


Figure 10. Typical TBP and Flash Curves.

flat S-shaped curve through the TBP plot, conforming somewhat to the major humps and plateaus of the TBP curve. This S-shaped curve, passing through the dew and bubble points, is then the estimated complete flash curve.

This method may appear to be too simple, particularly when being compared with the many elaborate methods which have been published. However, its use for quickie estimates is reasonably accurate, self-checking, and rapid, requiring little more time than that needed to determine the dew and bubble points.

If greater accuracy is required, the "first trial" value of Percent V (and therefore of C, which equals Percent V/(100-Percent V)) may be read from the estimated complete flash curve at system temperature and inserted in Equation 1, along with the proper K-constants and feed composition. This will produce a "first calculated" value of C, which probably will not be quite the same as the "first trial" value of C but should be close. These and subsequent trial values may be plotted against their respective calculated values for interpolating to the correct value of C, wherein the assumed and calculated C's are equal.

The composition of the two phases may readily be determined when the correct value of C is known. In Equation (1), $1/(1+C)$ is equal to L, the total mols of liquid per mol of feed. L, in turn, is equal to the sum of mols of individual liquid components which are respectively $f_1/(1+K_1C)$, $f_2/(1+K_2C)$, $f_3/(1+K_3C)$, and so on. Then with component No. 1 as an example, $f_1/(1+K_1C)$ divided by L is the mol fraction of component No. 1 in the liquid phase, and when this mol fraction is multiplied by K_1, the product is the mol fraction of component No. 1 in the vapor phase. Thus the composition of the two phases may be calculated, component by component. This indirect method of determining the composition of the vapor phase may result in a failure of the mol fractions to total 1.0, but the small summation error may be readily spread through all components.

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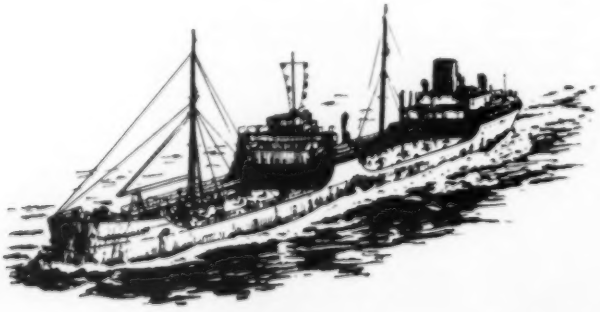

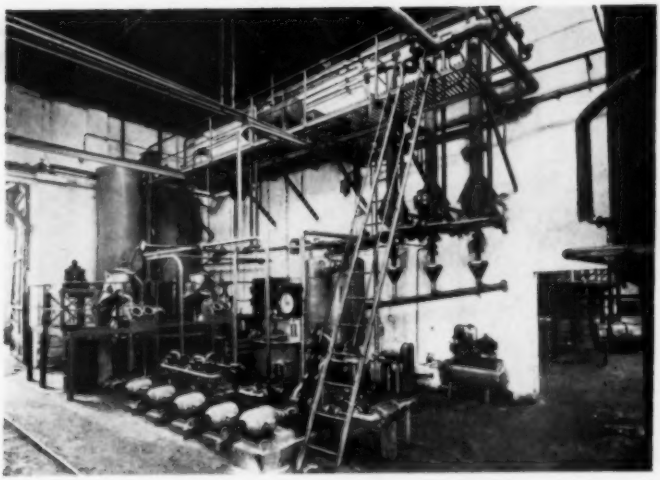

Acid Treatment Installation at Permolio Refinery (Milan), Showing the Pumps in the Foreground, the First and Second-Stage Separators to the Left, and the Three Reaction Columns for the First Treating Phase to the Right.

Lube Oil Acid Treatment Developed for Italian Refineries

Two-stage, centrifugal process offers advantage of higher yield and reduction in chemical consumption over the single-stage.

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Separator-Nobel Company, Stockholm, Sweden

ALTHOUGH Italy is one of the youngest oil-refining countries, the developments have been rapid there both in the construction of refining equipment and in the consumption of petroleum products. Italy's first step toward modern refinery development was just before 1930, with duty exemption to refiners on imported topped crude. This measure encouraged construction of the cracking-type refinery—a thermal cracker of the Dubbs type with the necessary treating and re-run equipment. Then, too, the refineries at La Spezia (Royal Dutch-Shell), Naples ("Petrofina"), and Venice (originally owned by a Venetian group but later taken over by AGIP), were erected.

Italy had already a few complete refineries at that time, the largest of which were SIAP at Trieste and ROMSA at Fiume. They were of the design current in Central Europe before American petroleum technology had started to play a part there. SIAP and ROMSA were built when Trieste and Fiume belonged to the Austro-Hungarian Empire, i.e., before 1918.

Cracking refineries were followed by a period of more general refinery construction. A refinery was built in Trieste by "Aquila" and two others, one at Leghorn and the other at Bari, were built by the government-sponsored ANIC group. These last refineries were part of the program for the utilization of crude oil from the Italian-owned oil fields in Albania. The chief characteristics of the Albanian crude were the complete absence of light products and its high specific gravity. This crude represented an ideal charging stock for hydrogenation plants, and it was along this line that the ANIC refineries were laid out. Later, Vacuum Oil Company joined in and constructed a large refinery in Naples and absorbed the "Petrofina" plant. This new refinery contained the first catalytic cracking plant in Italy. It was of Houdry design and operated on the fixed-bed principle.

Because of Italy's geographical position, the crude oil treated during that period came chiefly from Roumania and Albania, although some Russian crudes were treated. Oils also were imported from the Western hemisphere and, just before World War II, some came from Iraq.

Despite an energetic exploration program, Italy had no home supply of crude. As World War II progressed, the situation of the Italian refineries deteriorated badly owing to a lack of crude. The only source available at that time, apart from Albania, was Roumania; but even this supply could not be maintained for very long. Moreover, the concentrated strategic bombing of the Allies caused considerable damage. The dismantling of intact refining plants by the German occupation authorities and their transportation to areas in Central Europe, which were thought to be better protected from air raids, completed the ruin.

Nevertheless, Italy, which before the war had processed about 1.5 million tons of crude oil per year in her 15 refineries, produced 3,100,000 tons in 1948 and the long term program envisages a throughput of 8,115,000 tons of crude oil in 1952-53 with an output of 7,329,000 tons.[1] This increase has been due to the decision of the larger oil companies to restore their refineries as quickly as possible by reconstructing the destroyed plants both with home-produced and imported equipment, and by increasing capacity and modernizing plants by installing new processes.

As far as their financial means and the market situation allowed, the smaller Italian-owned companies followed this example. The main reason why these smaller companies, who do not themselves have any holdings in oil fields, have been able to carry on, is that there is an exemption from a small customs duty of 120 lire (20 cents) per ton which is levied on imported finished products, but not on crude oil. Recent Italian legislation has also favored the installation of catalytic reforming plants.

Process Scheme

Turning to the development that the

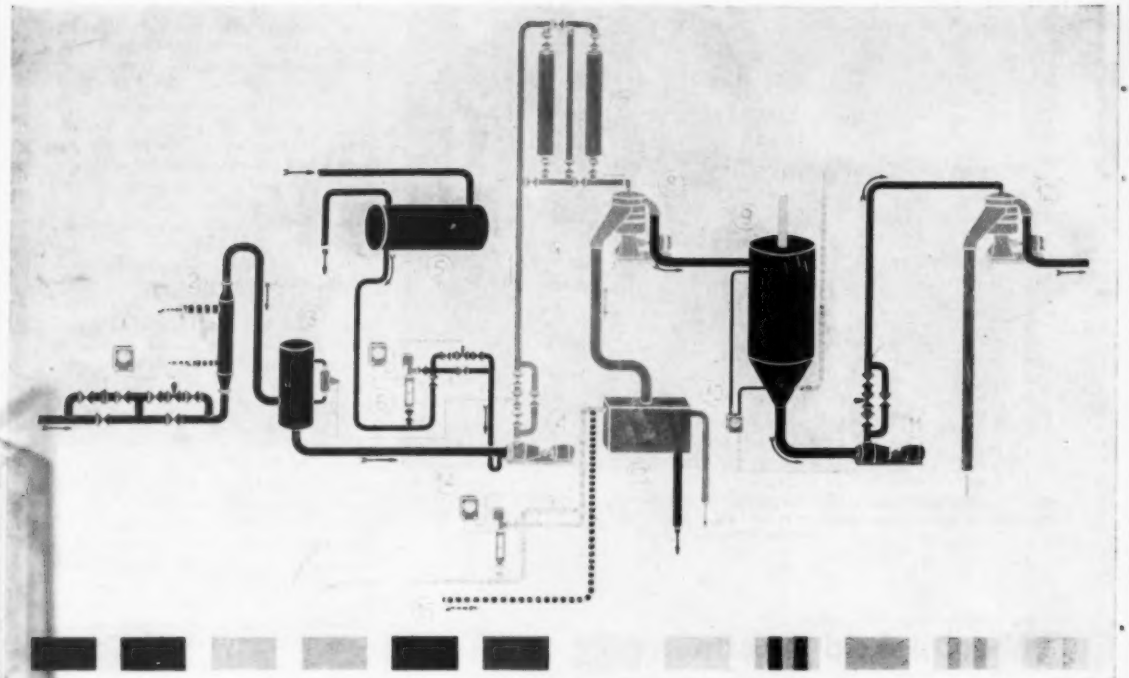

Figure 1. Simplified Flow Chart of Typical Two-Stage Lube Oil Refining Plant.

acid refining of lube oils has achieved within the framework of the general progress and modernization of Italian refining plants, it should be noted that both large and small refineries have adopted the latest type of centrifugal acid refining process both for finishing solvent extracted oils, where this is necessary, and for the direct acid treatment of distillate lubes of various grades. Refineries which use this scheme include Raffineria di Napoli (Socony-Vacuum Oil Company), Naples; SIAP (Esso), Trieste; STANIC (Standard Oil-ANIC), Leghorn; "Aquila," Trieste; ANIC, Novara; "Permolio," Milan; and ICEP, Milan.

Principle of Process

The principle of this process is as follows: through efficient mixing and a very short contact time, a selective action of the acid on the oil is obtained, in which physical extraction prevails over chemical reactions. The acid-oil mixture is then instantly separated. The spent acid from this stage is considerably more fluid than conventional acid sludge, and can be regenerated either separately or after blending with the secondary sludge. The method to be chosen depends entirely on the refinery's particular need in regard to fuel or recovered sulfuric acid.

The centrifuged oil is then subjected to agitation with air for a short time. In this stage, sulfuric acid, which has been allowed to remain in the oil and which is sub-colloidally dispersed, reacts chemically with the oil. The conditions of this reaction are controlled in such a way as to allow the best utilization of the acid on the one hand and to give a desired consistency of the acid sludge on the other in order to make it easily separated and pumped.

In Figure 1, the diagram shows the flow through a standard type of plant. The charged oil flows through a recorder controller (1) and a preheater (2) into a surge tank (3) fitted with a liquid level controller. From here it is picked up by the mixing pump (4). Sulfuric acid is fed by gravity from a day tank (5) through a recorder controller (6) into the suction side of the pump (4), where the initial mixing takes place. The oil-acid mixture then passes through contact columns (7) where the initial mixing is maintained for the desired period. This varies for optimum contact conditions but is not usually longer than a few minutes.

Avoiding Acid Action

In this way, practically all chemical action of the acid on the oil is avoided; and the undesirable components in the oil are mainly removed by extraction.

In the centrifugal separator (8), the acid sludge which has been formed is separated from the oil. The centrifuged oil containing finely dispersed acid passes continuously through an air-blowing tank (9) where a constant level is maintained by the aid of the liquid level controller (10).

Generally the blowing time varies from a few minutes up to half an hour depending on the type of oil treated. The secondary acid sludge formed during the blowing operation is then separated in centrifuge (12). Pump (11) is used to transfer the oil-sludge mixture from the air-blowing tank (9) to the separator (12).

In unit (13), the primary sludge is split into oil and dilute acid by being mixed with water from the meter (14). If heating is required, steam is admitted through (15).

A unit comprising two centrifugal separators, one for the first and one for the second stage, can handle 1500

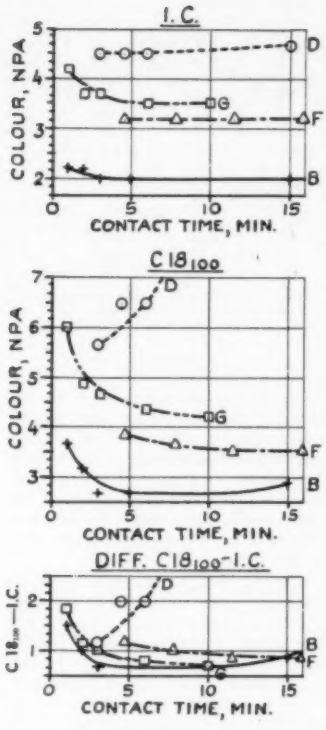

Figure 2

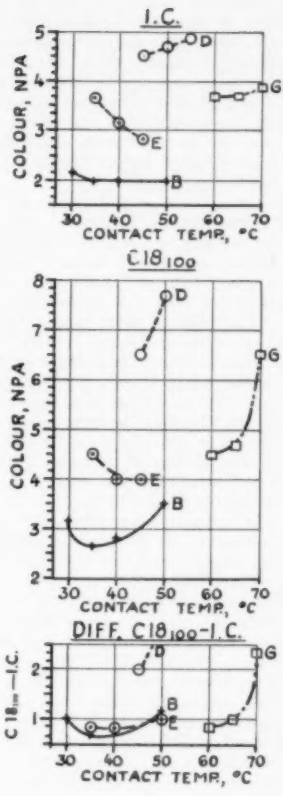

Figure 3

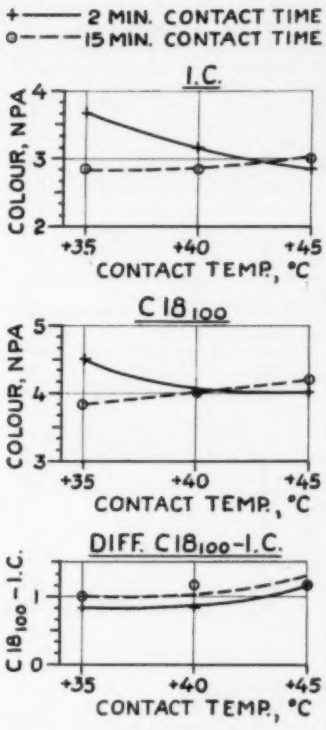

Figure 4

gallons per hour of a spindle oil 120 SSU @ 100° F. down to 400 gallons per hour of an oil 1225 SSU @ 100° F. The throughput for an oil of 500 SSU @ 100° F. is about 800 gallons per hour.

The two-stage continuous centrifugal refining process is a logical development of the single-stage process used before the war. Its principal advantages are higher yield and a considerable reduction in chemical consumption. Some data of the pilot plant test runs which illustrate in detail what has been said above, are discussed below.

Process Variables

The oils chosen were as representative as possible including oils from the Near and Middle East and from Venezuela. For the sake of simplicity the oils are designated by letter. See Table 1.

Refining variables were carefully adjusted even in the first stage. Thus, contact time, contact temperature, and acid concentration, were adjusted according to the characteristics of the oil so that optimum results were obtained. In order to get a clear idea of the refining effect, the color stability, as well as the color of the refined oil (I.C.), must be determined. This is done by determining the color deterioration in the refined oil when it is kept in a standardized iron vessel for 18 hours at 100° C. The colors are determined in accordance with the NPA Scale. The color number thus obtained is shown in the graphs as "C 18_{100}." The numerical difference in color between a sample of oil which has undergone stability tests and a freshly refined oil has been expressed as "Diff. C 18_{100} minus I.C." This difference constitutes a measurement of the color stability of the refined oil.

Contact Time. Figure 2 shows some typical contact time curves for a number of the oils in the table.

Acid refining and after treatment of the separated sour oil was carried out under the conditions shown in Table 2.

The initial color (I.C.) alone does not give any clear indication of the reaction time required. The stability

TABLE 1

Designation	Origin	Viscosity E° 50 °C.	Viscosity E° 99 °C.	Viscosity S.U. 130 °F.	Viscosity S.U. 210 °F.	Sp. Gr. 20 °C.
A	Venezuela	2.20	.....	66.0	.....	.924
B	Venezuela	2.67	.....	79.5	.....	.924
C	Venezuela	7.70	1.78	218	57.3	.943
D	Aramco	8.54	1.94	245	63.4	.923
E	Venezuela	9.88	1.91	275	62.3	.929
F	Pakistan	11.72	2.02	325	66.5	.923
G	Pakistan	28.1	3.04	750	104.0	.932

TABLE 2

OIL	ACID TREATMENT: Quantity Percent By Weight	ACID TREATMENT: Conc. Percent	ACID TREATMENT: Temp. °C.	AFTER-TREATMENT WITH CLAY: Type	AFTER-TREATMENT WITH CLAY: Quantity Percent By Weight	AFTER-TREATMENT WITH CLAY: Temp. °C.	AFTER-TREATMENT WITH CLAY: Time Min.
B	3.0	98.0	35	W	4.0	60	60
D	5.0	96.0	45	Y*	2.0	70	60
F	2.5	96.0	50	Z	1.5	120	20
G	5.0	95.0	65	Z	3.0	120	20

* Besides the clay, one percent of lime was added to this oil.

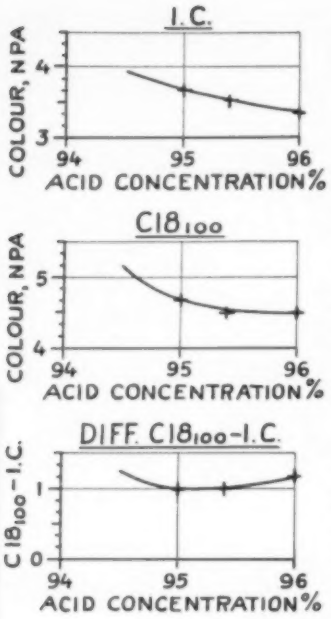

Figure 5

test however, does give a clear result. The oils, B, F and G thus need a minimum of about four minutes reaction time, while oil D is sensitive to the reaction time, and probably needs less than three minutes.

If the reaction times are lengthened, a gradual deterioration in the quality of the oil occurs as colored ingredients, as well as components which cause a deterioration in color stability, become redissolved in the raffinate from the acid sludge phase. Apart from oil D, which shows this clearly, this tendency also occurs in oil B. With oils F and G a longer reaction time than that shown, is necessary for deterioration to occur.

Temperature. The contact temperature is a variable, to which great attention must be paid. The temperature curves in Figure 3 are for oils refined in the way shown in Table 3.

The optimum contact temperature is usually within the temperature range for which the viscosity of the oil is between 3 and 10° E. Too high a temperature causes the oil to become discolored (burned) while with too low a temperature the viscosity of the oil is so high that it becomes difficult to mix the oil and acid properly and to carry out the separation efficiently.

Clear optimum points can be seen on the curves shown.

The contact time and temperature are interdependent. Figure 4 shows curves relating to oil E (for refining conditions see Table 3) and these show the effect of various contact temperatures with two different contact times. With a short contact time the best color of the raffinate (I.C.) was obtained when a high temperature was used, while with a long contact time the best result was achieved with a low temperature. The same raffinate color can be obtained in both cases. The color stability is somewhat better with a low temperature both with a short and long contact time.

Acid Concentration. The effect of the concentration of the acid on the refining result is shown in Figure 5. The curves relate to oil G.

The acid treatment was carried out a +65° C. with a contact time of three minutes. The amount of acid was 5 percent (calculated as 100 percent H_2SO_4). The treatment with clay was carried out in the same way as described for oil G in Table 3.

The color (I.C.) of the refined oil improves with an increased acid concentration. The color stability has, however, an optimum and in most cases it is not therefore suitable to use too strongly concentrated acid.

Air Blowing Time. When the optimum conditions in the first stage are fixed, the air blowing time required has to be determined. Air blowing is of great importance since it causes a reduction in acidity of the raffinate. The time required to reach the optimum result varies for different oils and can easily be determined. The curves show the decrease in the acid value obtained in an acid-treated oil after various air-blowing times and with separation after air blowing.

The acid treatment was carried out under the conditions shown in Table 4.

As can be seen from Figure 6, a very large decrease in the acid value

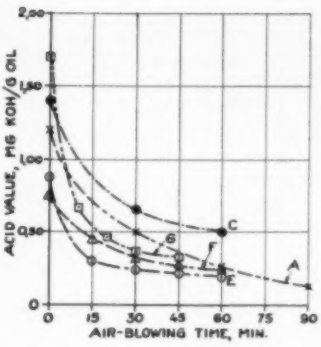

Figure 6

is obtained at the beginning of the air blowing. Gradually, the rate of decrease gets smaller until a stage is reached where the curve levels out. The air-blowing time should be limited so that the sludge does not become hard. Hardening does not usually occur until the asymptotic part of the curve is reached.

As has been pointed out, with air blowing of the oil followed by separation of the secondary sludge, the amount of chemicals needed for the after-treatment can be reduced. This is of great importance from an economical point of view as clay is expensive. On the other hand, if the same amount of after-treatment chemicals is used as before, a better final result is obtained. Figure 7 will make this clear.

Figure 7 shows contact time and reaction temperature curves for oil D, for both the one-stage method and the two-stage method with air blowing. The refining conditions were the same as given for this oil in Tables 2 and 3. Air-blowing time 10 minutes.

Stages. Figure 8 gives a comparison between the one-stage and the two-stage method at various temperatures for oil G. The conditions were the

TABLE 4

OIL	Quantity Percent By Weight	Conc. Percent	Contact Time Min.	Temp. °C.
A	2.5	96.0	1	40
C	2.25	96.0	1.5	55
E	3.56	96.0	2	45
F	3.0	96.0	3	55
G	5.0	95.2	3	65

TABLE 3

OIL	ACID TREATMENT			AFTER-TREATMENT WITH CLAY			
	Quantity Percent By Weight	Conc. Percent	Contact Time Min.	Type	Quantity Percent By Weight	Temp. °C.	Time Min.
B	3.0	98.0	5	W	4.0	60	60
D	5.0	96.0	6	Y*	2.0	70	60
E	3.56	96.0	2	W	2.0	150	20
G	5.0	95.0	3	Z	3.0	120	20

* Besides the clay, one percent of lime was added to this oil.

TABLE 5

OIL	COLOR		CHEMICAL CONSUMPTION PERCENT			
			One Stage		Two Stage	
	I.C.	$C18_{100}$	Clay	Lime	Clay	Lime
A	2.00	2.17	1.50	.30	.50	.30
C	3.00	3.50	2.50	.30	1.10	.70

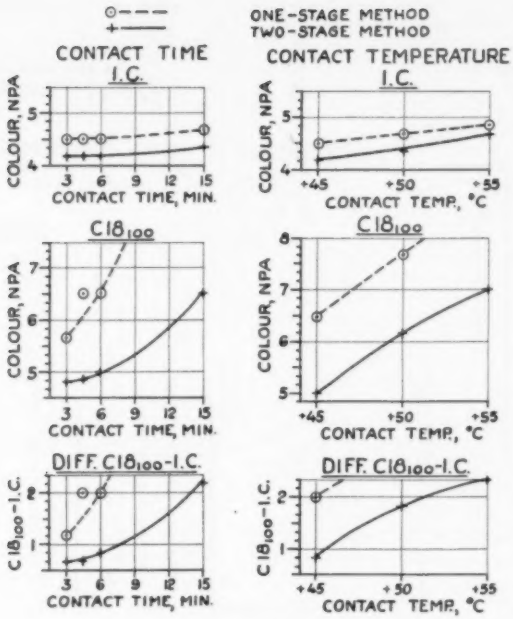

Figure 7

same as those shown in Table 3. Air-blowing time 20 minutes.

Apart from a better color in the raffinate for the same consumption of chemicals, a somewhat lower sensitivity to the adjustment of refining conditions is obtained with the two-stage method.

Chemical Consumption. Table 5 gives the consumption of after-treatment chemicals for refining to a constant color and color stability with oils A and C. The amount of sulfuric acid was kept constant with both methods. With oil A it was 2.5 percent and with oil C 2.25 percent.

Table 6 shows the cost of chemicals for the after-treatment of about 30,000 tons per year of oils A and C. The cost of the clay is reckoned as $55.50 per ton and the price of lime $9 per ton.

The saving in chemicals also plays its part in the reduction of refining losses. How important this may be, calculated, say, on a year's production, can be understood from the figures given for the consumption of chemicals in Table 5 especially if it is remembered that one part of clay-lime can cause the loss of one part of oil.

TABLE 6

	COST OF CHEMICALS IN DOLLARS PER YEAR						Percent Saving With Two Stage Refining
	One Stage			Two Stage			
OIL	Clay	Lime	Total	Clay	Lime	Total	
A	24,950	810	25,760	8,320	810	9,130	64.6
C	41,600	810	42,410	18,320	1,890	20,210	52.3

Plants of the type described have also been erected in several refineries in which the hookup also allows the two separators to be operated in parallel or in separate cycles when special oils are to be produced, such as various types of technical white oils and medicinal white oil.

Sludge Disposal. It is generally considered that at least 20 tons of acid sludge per day should be available in order to make a plant profitable. For refineries not having such quantities of sludge or not wanting to install regeneration plants of the types mentioned, the alternatives left are calorific recuperation by burning the sludge under boilers or chemical recuperation by hydrolyzing the sludge and separating the hydrocarbon oil from the dilute acid. The oil is generally used as fuel and the sulfuric acid can be used in the manufacture of superphosphate and for other applications in the chemical and the petrochemical industries, either as such or after concentration. In gas works, the dilute acid can be used for adsorbing ammonia vapors.

It is well known that acid sludge obtained from centrifugal plants using controlled reaction time is considerably more fluid and less polymerized than sludge from settling processes, and therefore, sludge which is hydrolyzed immediately after coming out of the acid sludge centrifuges allows better recovery of acid because the free acid in the sludge has not had time to react further with the hydrocarbons. It has been found that, in order to obtain phase separation between the oil and dilute sulfuric acid, a greater amount of water must usually be added than is absolutely necessary for properly hydrolyzing the sludge. When using a small centrifugal separator suitably protected against corrosion, the amount of water necessary for hydrolysis can be reduced, and the acid obtained in this way is considerably more concentrated than when phase separation is carried out by gravity. In the cases of certain sludges which are difficult to hydrolyze, a varying amount of tar-oil is added simultaneously with the water in order to act as a solvent for the heavy asphaltic constituents of the tar.

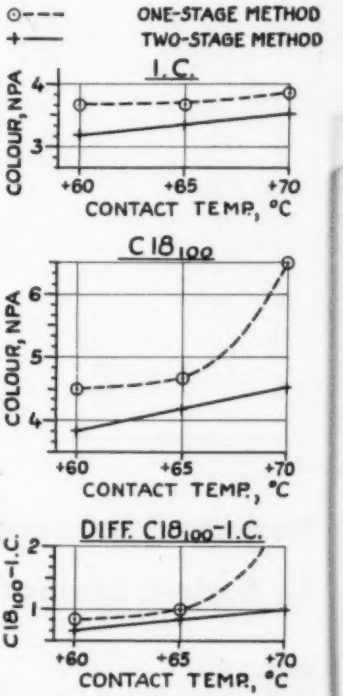

Figure 8

REFERENCE

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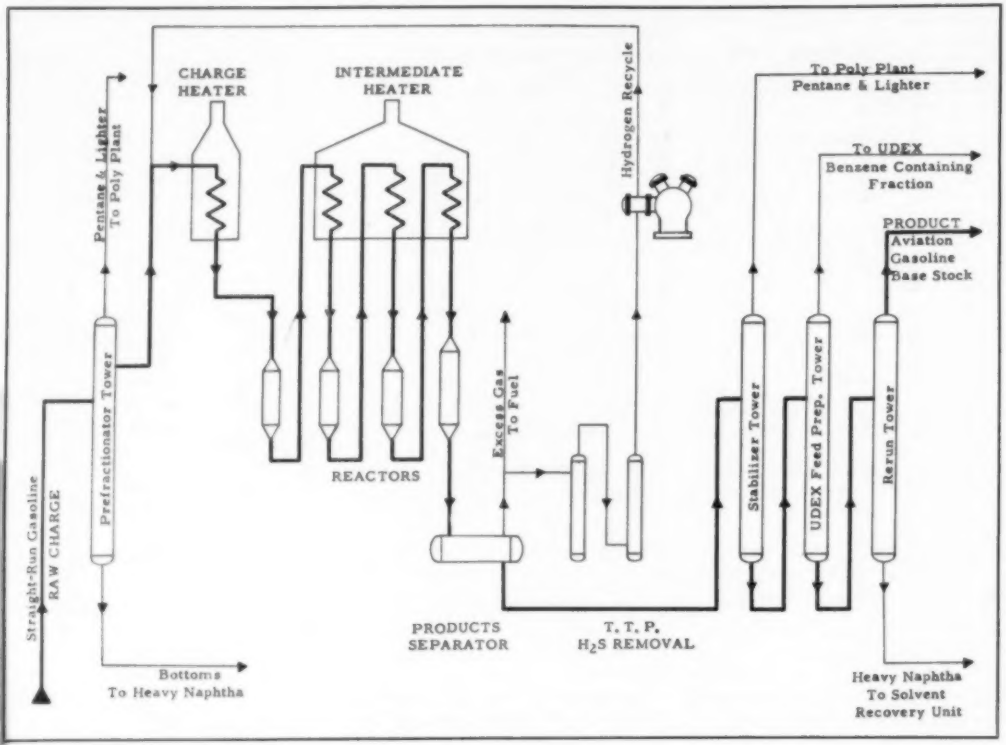

How the Platformer Is Applied To Eastern States Operation

SEVERAL unique features are incorporated in the Platformer which was recently installed at the plant of Eastern States Petroleum Co., Houston.

The raw charge to the Eastern States unit can consist of straight-run gasoline produced at Plant No. 1 or natural gasoline or light distillates from outside sources. The total raw material goes to a prefractionator tower where the actual platformer charge is prepared by selecting just the material which at the time will produce the desired product.

The material lighter than the platformer charge is then taken to the poly unit gas handling equipment where it is combined with other gasoline. The material heavier than the platformer charge can be either recombined with our gasoline or directed to gasoil or used for specialty purposes depending upon the character of the material at any particular time and the general operation of the refineries.

The selected cut from the prefractionator is combined with high-purity recycle hydrogen and heated to the reaction temperature of over 900° F. in the first or charge heater. This material then passes through No. 1 reactor which is packed with a platinum catalyst in the form of pellets approximately 1/16 inches in diameter by 3/32 inches long.

The complex chemical reactions which take place in the presence of the platinum catalyst cause a loss of heat so that it is necessary for the material to be again brought up to reaction temperature on its travel through each of the remaining three reactor vessels and over the three remaining catalyst beds. From the fourth reactor the material goes to a product separator where light gases are taken off to be recycled or sent to the plant fuel system when production of such gases exceeds the need for recycle.

The hydrogen recycle from the product separator is sent through a TPP unit for the removal of H_2S before being picked up by two 600-horsepower compressors and compressed to 600 pounds per square inch and combined with the fresh feed to the charge heater.

The liquid from the product separator goes to the stabilizer tower where pentanes and lighter gases are taken overhead to the poly unit gas handling equipment and combined with other gasolines. The bottoms from the stabilizer tower is sent to the UDEX feed preparation tower where the benzene containing fraction is taken overhead and sent to the UDEX unit for further purification.

The bottoms from the UDEX feed preparation tower then go to a rerun tower where aviation base stock, the finished product of the platformer is taken overhead. The bottoms from the rerun tower are a heavy solvent naphtha which can be further refined into a variety of products.

Variable Head Suspended Level Viscometer

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THE instrument to be described was designed primarily for the purpose of taking viscosity-temperature curves on liquids over a wide range of temperature, and hence a wide range of viscosity. In connection with investigations on crude petroleums, a viscosity-temperature curve over a range of as much as 200° F. is frequently required. This results in the use of a number of the ordinary types of viscometer, or alternatively, very long times of efflux at the high viscosities. The use of an instrument having a variable head in order to obtain a wide range of viscosity measurements within a reasonable range of efflux times offers a solution to this problem. The present instrument was designed to use the suspended level principle of Ubbelohde[5, 9] which has been adopted for viscosity measurements on petroleum oils[7] and has been modified by various authors.[4]

The instrument finally designed requires less than 3 ml. of liquid to run a complete test, is accurate to better than 1 percent on viscosity, and when used in a vacuum-jacketed bath, which is described, permits taking a viscosity-temperature curve for a liquid in one to two hours. The use of the instrument to detect anomalous viscosity, (i.e., to act as a consistometer) has been checked and it appears that instruments of this design may be of value in applications involving "non-Newtonian" fluids.

A NEW type viscometer is described having an exceptionally wide viscosity range. Using the suspended level principle of Ubbelohde together with a variable head, this viscometer was especially designed for determining oil viscosity curves over wide temperature ranges.

The new instrument requires a sample of less than 3 ml., and is said to be accurate to better than 1 percent. In addition to the determination of oil viscosities, the instrument can also be used for the detection and measurement of the properties of non-Newtonian liquids.

Description of Instrument

A sketch of the instrument showing principal dimensions is shown in Figure 1. Construction is of Pyrex glass, the measuring portion being made from a calibrated 1 ml. transfer pipette graduated in 0.01 ml. subdivisions. The lowest graduation (1.0 ml.) is placed less than 5 mm. above the top of the capillary, which is blown of precision bore tubing or selected capillary. The suspended level is prepared in accordance with the specifications of Ubbelohde to have a hemispherical form.[8] The three vertical tubes, namely, filling tube A, measuring tube B, and suspended level tube C, are arranged in the form of a triangle rather than in a single plane as shown in Figure 1. Levelling and control stopcocks and filling tube caps are attached through standard taper joints.

The whole viscometer is mounted in a transparent Dewar flask, being cemented in a bakelite cover. The cover contains openings for filling the flask, for a motor driven stirrer, a knife type heater, a thermometer, and for a dilatometer if required. A levelling vial is mounted on the cover. The whole apparatus is shown in Figure 2.

Operation

In operation, a sample is introduced to the filling tube A of the viscometer by pipette and the vacuum jacket filled with water at the highest temperature at which measurements are to be made. Test runs are made with a "split second" type stop watch, permitting time readings for each 0.1 ml. of sample discharged.[6] The results of a single test run will give up to 10 actual measurements of viscosity, thus

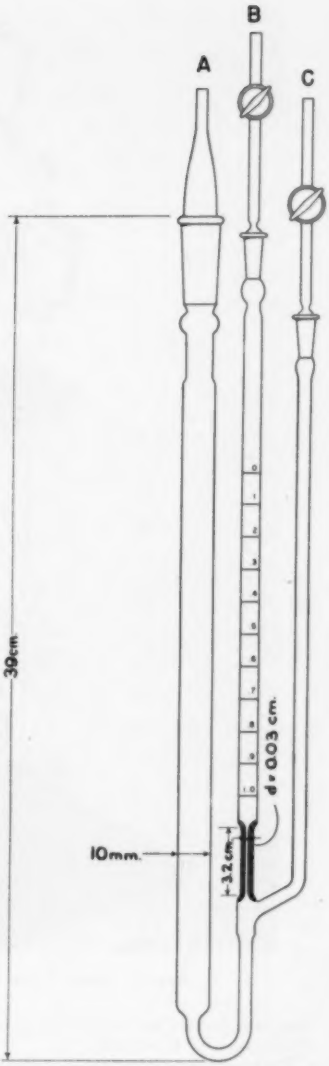

Figure 1. Sketch of Variable Head Suspended Level Viscometer, Showing Principal Dimensions.

giving checks on errors of calculation or interpretation.

The temperature of the bath is reduced by removal of some of the water and addition of cold water, and the test run repeated after allowing temperature equilibrium to be reached (usually 5 minutes). This procedure of reducing bath temperatures and making runs is repeated until the lowest temperature required is reached, after which the series of readings is repeated by operating the heater unit and running a second series of tests at increasing temperatures. By the use of suit-

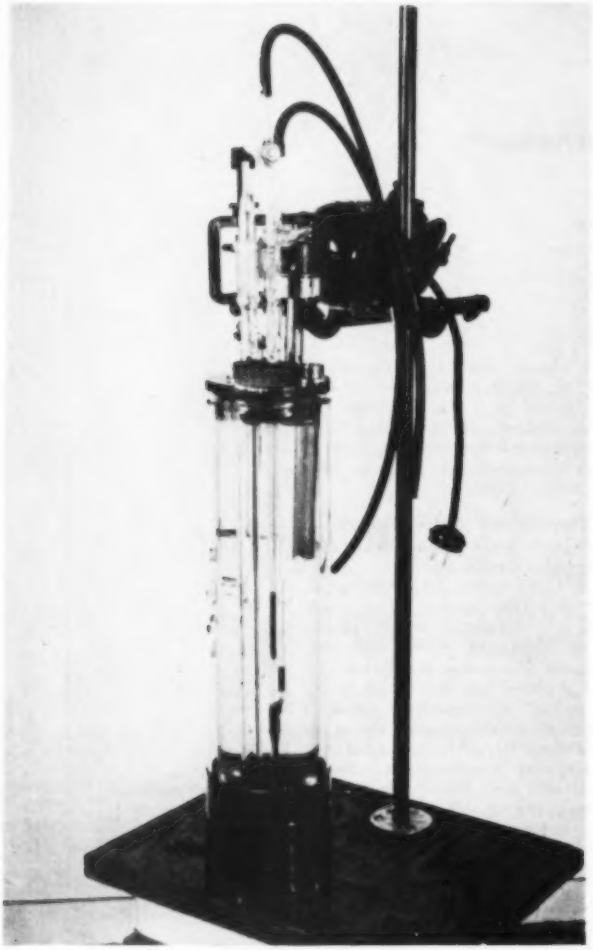

Figure 2. Assembled View of Improved Liquid Viscometer.

able bath liquids test runs have been run from —70° C to +140° C.

The readings as taken are converted to kinematic viscosities (in centistokes) by multiplying the times by the calibration factors. To obtain the viscosities in centipoises the kinematic viscosities must be multiplied by the liquid density at the temperature of test. In tests with petroleum oils this may be done by interpolation in Table 1, in which the densities of petroleum oils are given over a temperature range of 0° to 240° F.

In work involving liquids of unknown density-temperature relationships a small dilatometer is placed in the bath and read during the viscosity determinations. This instrument consists of a 10 ml. bulb sealed to a 1 ml. pipette graduated in 0.01 ml. and readable to 0.001 ml. The unit is equipped with a ground glass stopper with spring lugs. It is calibrated with water at several points on the scale and at a few temperatures. A similar counterpoise is used in the original weighing. Densities may be determined to 0.01 percent.

Calibration of Instrument

The viscometer is calibrated using liquids of known viscosity, suitable materials being selected for the particular range of instrument in use. In the unit described, the liquids used were chloroform,[11] aniline,[7] and water.[11] A series of readings were taken on each liquid at various temperatures and the factors to convert efflux time (seconds) to kinematic viscosity (centistokes) were computed. The results of the calibration are summarized in Table 2.

The standard deviations indicate a precision on single tests of about 1 percent: this corresponds to a volume reading accuracy of 0.001 ml., or one tenth of the 0.01 ml. divisions of the pipette. In other forms of this instrument slightly higher precision has been obtained by the use of larger tubing of uniform bore with wider spacing, but for the purposes for which this model was constructed, further refinements were not considered to be justified. Results indicate that even at high rates of flow at the

TABLE 1
Densities of Petroleum Oils of Various Gravities Over the Temperature[12] Range 0 to 240° F.

Gravity (°API)	DENSITY Gm. /Ml. at T. (°F.)															
	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80
Temperature																
°F.	°C.															
0	— 17.8	1.055	1.017	0.984	0.952	.923	.895	.868	.845	.822	.801	.781	.763	.745	.728	.712	.699
20	— 6.7	1.048	1.011	0.978	0.945	.916	.888	.861	.838	.815	.793	.773	.754	.736	.719	.702	.689
40	4.4	1.042	1.005	0.971	0.939	.910	.882	.854	.831	.807	.786	.766	.746	.727	.710	.693	.679
60	15.6	1.036	0.999	0.965	0.933	.903	.876	.849	.824	.800	.779	.758	.738	.719	.702	.685	.668
80	26.7	1.030	0.993	0.958	0.927	.896	.868	.841	.816	.793	.770	.749	.729	.709	.691	.674	.656
100	37.8	1.025	0.987	0.952	0.919	.890	.861	.834	.809	.785	.762	.740	.720	.700	.681	.663	.644
120	48.9	1.019	0.980	0.944	0.913	.883	.853	.825	.801	.777	.755	.731	.711	.689	.671	.651	.632
140	60.0	1.013	0.974	0.938	0.907	.876	.846	.817	.793	.769	.746	.723	.702	.681	.661	.641	.622
160	71.1	1.007	0.968	0.933	0.901	.870	.839	.810	.786	.761	.738	.714	.693	.670	.650	.629	.609
180	82.2	1.002	0.962	0.928	0.895	.864	.832	.802	.778	.753	.728	.704	.683	.660	.638	.617	.597
200	93.3	0.996	0.956	0.922	0.889	.856	.824	.795	.771	.744	.719	.696	.673	.650	.627	.606	.584
220	104.4	0.990	0.950	0.916	0.882	.850	.817	.786	.762	.735	.709	.686	.662	.639	.616	.595	.570
240	115.6	0.983	0.943	0.909	0.875	.844	.809	.778	.753	.725	.699	.674	.651	.628	.604	.581	.556

greatest head in the instrument (0.0-0.1 ml.) there is no significant kinetic energy correction at viscosities as low as 0.9 centistokes.

In considering the extended range of the instrument, it will be noted that the conversion factors given in Table 2 cover a 19 fold range. If, for practical purposes in routine operations, we assume the useful range of a viscometer to be over a 10-fold time range (say 60 to 600 seconds) then the instrument covers a range of viscosity of 190-fold (in this case from 0.3 to 64 centistokes).[4] Thus the use of this type of instrument results in two distinct advantages as compared to various single-bulb type of viscometers: the viscosity range is extended considerably, and single test runs with a split-second type stopwatch permit of a number of check measurements during a single run.

Use as a Consistometer

The use of a variable head viscometer for the detection and measurement of the properties of non-Newtonian liquids has been discussed by Herschel and Bulkley.[6] Using the calibration data given in Table 2, together with necessary dimension measurements as measured by a cathetometer, the equations to relate flow rate to mean head were computed by the method of least squares. The mean diameter of the capillary, by the Meissner formula,[6] was 0.02995 cm., as compared to 0.29 cm. by microscopic measurement with a simple eyepiece micrometer. The average deviation was less than 0.01 cm.

TABLE 2

Calibration of Viscometer

Viscometer Range	Conversion (η/T) to Convert Seconds to Centistokes	NUMBER OF TESTS			Standard Deviation of Single Test, Percent
		Water	Aniline	Chloroform	
0–0.1	0.1095	11	8	0	1.8
0.1–0.2	0.0998	7	8	0	1.3
0.2–0.3	0.0902	8	8	0	1.3
0.3–0.4	0.0811	7	9	0	1.2
0.4–0.5	0.0719	9	8	0	1.0
0.5–0.6	0.0643	9	7	0	1.3
0.6–0.7	0.0561	8	9	0	1.5
0.7–0.8	0.0470	6	9	0	0.8
0.8–0.9	0.0382	6	9	2	1.0
0.9–1.0	0.0290	8	9	2	2.3
0–0.1	0.1095	11	8	0	1.8
0–0.2	0.0524	9	8	0	1.5
0–0.3	0.03310	11	8	0	1.1
0–0.4	0.02351	10	9	0	1.0
0–0.5	0.01770	10	7	0	0.8
0–0.6	0.01390	9	9	0	0.8
0–0.7	0.01111	9	9	0	1.1
0–0.8	0.00900	9	9	0	1.1
0–0.9	0.00727	9	9	0	1.0
0–1.0	0.00580	9	9	0	1.2

The instrument was tested on starch solutions and solutions of soap in kerosine. The variation in viscosity with head was readily detected and yield shear values could be obtained by the usual procedures.[5, 6]

For the detection of non-Newtonian liquids the involved procedures of calibration used are unnecessary: a single run using measurements over the whole volume range serves to indicate the phenomenon by the increase of calculated viscosity as the flowing head is reduced.

For detection of structure on liquids the instrument is useful, but a somewhat different dimensional design would be preferable for measurements of shear value and stiffness.

ACKNOWLEDGMENTS

This type of instrument was first developed by the writer while at the Canadian Army Experiment Station, Ralston, Alberta, during World War II. The further development to the present form has been completed in the Research Engineering Division of Imperial Oil Limited.

The kind permission of both organizations to publish this paper is gratefully acknowledged.

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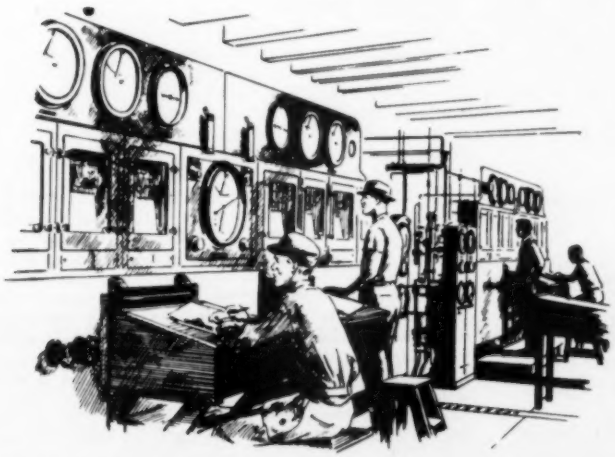


Free Sulfur Determination Reduced to 15 Minutes by New Method

More accurate and reproducible results are also claimed for this new procedure

O. R. MITCHELL

Magnolia Petroleum Company, Beaumont, Texas

THE conventional combustion methods of determining free sulfur in petroleum products are tedious, time-consuming, and often inaccurate. A procedure has been developed which is a modification of the method used by Uhrig and Levin[1] in the determination of free sulfur in gasolines. The turbidity resulting from the reaction of free sulfur with metallic mercury is used as a measure of the free sulfur.

This modification has been found to be not only more accurate and reproducible than the conventional methods but also reduces the test time from 1 to 6 hours to about 15 minutes. The free sulfur is determined directly, whereas the conventional methods involve the determinations of the total sulfur either before and after the free sulfur addition or before and after its chemical removal.

Specific application has been made to the analysis of cutting oils containing between 0.3 and 1.3 percent free sulfur. A description of the method used is as follows:

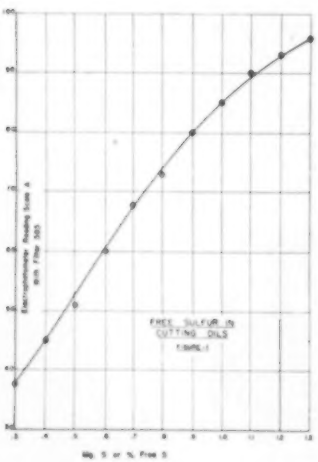


Figure 1.

Outline of Method

A sample of the cutting oil is diluted with Stoddard solvent and shaken with metallic mercury. The amount of the mercuric sulfide formed and suspended in the solution is used to determine the free sulfur. The percentage of free sulfur in the oil is obtained from a reading on an electrophotometer by reference to a calibration curve.

Reagents

CP mercury
CP benzene
Lump sulfur
Stoddard solvent

Apparatus

5-ml pipette
10-ml graduated cylinder
100-ml graduated cylinder
100-ml beaker
250-ml mixing cylinder
1000-ml volumetric flask
4-ounce bottles
AC Model-Fisher Electrophotometer
Filter 585 for above electrophotometer
Mechanical shaker

Procedure

Standard mercuric sulfide suspensions are conveniently obtained in the following manner: 100-ml portions of Stoddard solvent are placed in each of 12 4-ounce bottles. Sulfur solution containing 1.00 gram of sulfur per 1000 mls of benzene solution is added to 11 bottles in 0.1-ml increments starting with 0.3 ml and with the eleventh bottle containing 1.3 mls of solution. The twelfth bottle does not contain the sulfur solution. Three mls of mercury are added to each bottle. Bottles are shaken vigorously for exactly five minutes. The mercuric sulfide suspension is decanted from each bottle into a 250-ml mixing cylinder, diluted with one-half its volume of Stoddard solvent, and mixed thoroughly immediately before it is transferred to the electrophotometer cell. This additional dilution is made to give suitable readings on the electrophotometer. Appropriate dilutions may be made in the first place provided the shaker will accommodate the size of bottle required. Readings are taken with Filter 585 and with the light intensity switch at position C. The sample containing no sulfur is used as a blank. The readings are plotted against the milligrams of free sulfur present. A typical calibration curve is shown in Figure 1.

To make a free sulfur determination on a cutting oil exactly 0.100 gram of the unknown oil is weighed into a 100-ml beaker. This is transferred quantitatively to a 4-ounce bottle with 100 mls of Stoddard solvent. Three mls of mercury are added from a 10-ml graduated cylinder. The bottle is tightly stoppered and shaken vigorously for exactly five minutes. The mercuric sulfide suspension is decanted into a 250-ml mixing cylinder, diluted with one-half its volume of Stoddard solvent, and mixed immediately before being transferred to the electrophotometer cell. A reading is taken using a blank prepared in the manner as described in the preparation of the standard mercuric sulfide suspensions. The color of the cutting oil is of no importance to the test because of the high dilution of the sample. The free sulfur is obtained directly from the calibration curve.

A comparison of results obtained using conventional methods and the above described procedure is shown in Table 1.

TABLE 1

Comparison of Various Methods of Determining Free Sulfur

Free Sulfur Added, Percent	Free Sulfur Determined, Percent		
	Combustion Method		
	Bomb	Vertical Tube	Direct Method
0.500	0.61	0.41	0.52
0.750	0.88	0.63	0.71
1.000	1.17	0.86	1.06

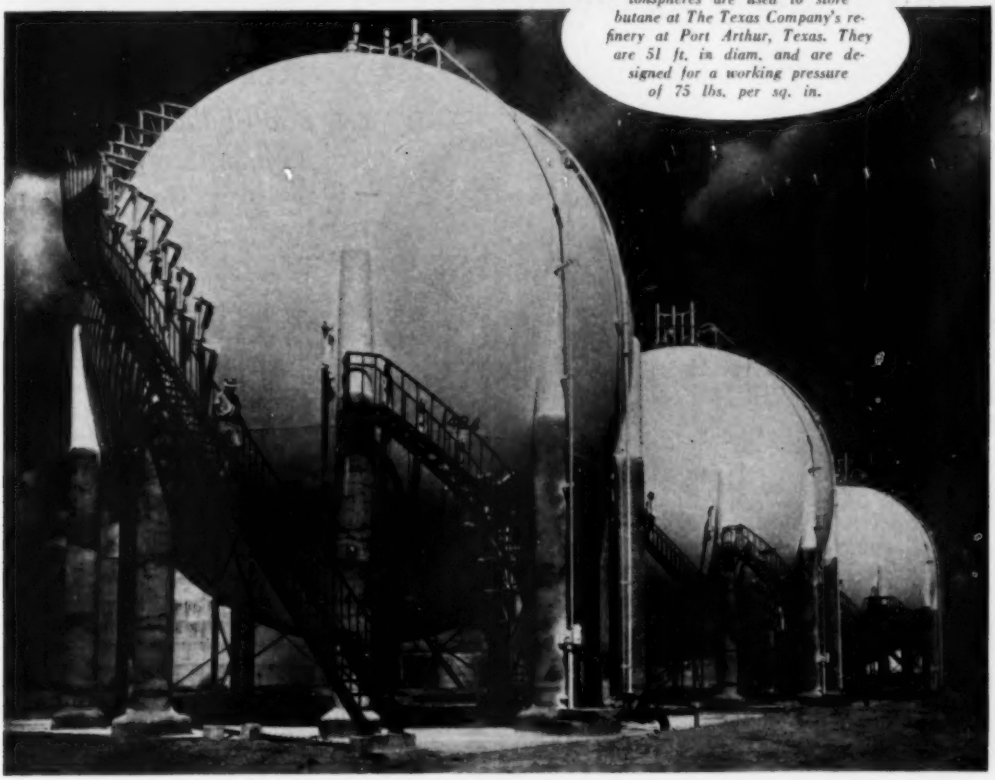
These results show that the direct method is more accurate than the conventional combustion methods.

Although an electrophotometer is mentioned in this method, visual observations are satisfactory. However, standards for visual comparisons rapidly deteriorate and must be renewed frequently, while calibration data once obtained on an electrophotometer can be used indefinitely.

REFERENCE

[1] Analytical Chemistry, 23, 1334 (1951).

SIX REASONS WHY HORTONSPHERES PROVE SUPERIOR FOR STORING BUTANE



These three 12,000-bbl. Hortonspheres are used to store butane at The Texas Company's refinery at Port Arthur, Texas. They are 51 ft. in diam. and are designed for a working pressure of 75 lbs. per sq. in.

1. **Economical Storage** — The spherical shape of a Hortonsphere enables us to build relatively large pressure vessels without exceeding the maximum plate thickness set forth in the governing code.

2. **Low Fire Hazard** — A Hortonsphere stores volatile hydrocarbons under pressure. During normal operation, no vapor is vented to create a fire hazard.

3. **Positive Protection** — The Hortonsphere prevents the escape of any of the contents as long as the internal pressure does not exceed the setting of the pressure relief valves.

4. **Minimum Corrosion** — Since oxygen is rarely present in a Hortonsphere — corrosion on the inside of the tank shell is materially reduced. A longer, more profitable life is assured.

5. **Dependable Service** — The Hortonsphere is a plain storage tank with no operating parts except the valves and fittings.

6. **Low Maintenance Costs** — A Hortonsphere is supported above the ground. All exterior surfaces are readily accessible for inspection and painting. Write our nearest office for information.

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Chicago 4	2463 McCormick Building	Los Angeles 17	1534 General Petroleum Building	Tulsa 3	1626 Hunt Building
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REFINER AUTHORS and Other Personalities

Information, formal and otherwise, about the men who write for PETROLEUM REFINER as well as others prominent in the processing industry.

Mitchell Is Teacher Who Turned Chemist

Owen R. Mitchell received his B. S. and M. S. degrees in chemistry from North Texas State Teachers College and taught science in the public schools of Texas for 13 years before joining the technical department of Magnolia Petroleum Company in 1941. His article on page 148, "Free Sulfur Determination Reduced To Fifteen Minutes By New Method," stems from the fact that for the last 10 years he has been interested in the development of new analytical methods applicable to problems encountered in the petroleum refining industry. Forty-one-year old Mitchell, father of four daughters and a son, claims his "big" year came in 1950 when he acquired a new baby, a house and a car. His off hours are spent with the family and in religious activities. Golf and tennis also lay claim to his spare time.

Professor, Engineer Describe Findings

It probably took a lot of staring into an electron microscope, but University of Texas Professor W. A. Cunningham and Engineer M. A. Vela put it to good use and came up with the unusual facts contained in their article, "Take a Look at Lime Base Greases Through an Electron Microscope," on page 110.

Cunningham is a native Texan who "likes it here, always glad to get back when I leave." He took his B.S. and M.S. degrees in chemical engineering from the University of Texas in 1927 and 1929, then worked for Texas Pacific Coal and Oil Company for one year, Freeport Sulfur Company for one year and Texas Potash Corporation for a year. After an ensuing stint with University Lands in San Angelo, Texas, Cunningham went back to Austin for his Ph.D. and became a member of the school's faculty. He married a Texas girl by the name of Mary Bolling in 1930 and now has one boy, a freshman in the University, and three girls "scattered from high school to the first grade."

Vela is another University of Texas ex-student, finishing work on his M.S. degree in 1950. Prior to college, he served for "about three years" in the Armed Forces in Europe. After finishing his interrupted college career, he went to work for Phillips Petroleum Company and married a girl from Kansas. "I've eaten wholesome food ever since," he says. He is currently a chemical engineer in the pilot plant branch of Phillips chemical engineering division, and devotes his off time to photography. "In Bartlesville I have the privilege of associating with some of the topflight amateurs in the field."

Robert J. Phillips

Bob Phillips is New 'Refiner' Staff Man

An expanded PETROLEUM REFINER editorial staff finds Robert J. Phillips established as Operation and Maintenance editor, he having assumed his duties on June 1.

Bob, a native Texan, took his chemical engineering degree from the University of Texas in 1948, and since that time has been engaged in a variety of professional activities. His last four years have been with Humble Oil & Refining Company at Baytown, Texas, where he held, successively, the ranks of junior engineer, assistant engineer and chemical engineer. His professional work has been primarily in distillation, extraction, economics, process design and planning of operations. He also has served as lecturer in several company-sponsored schools for new technical employes, for Armed Forces Munitions Board, etc. He has been active in AIChE affairs.

Between 1941 and 1945 Bob was in the U. S. military service, entering as a private and holding rank as captain when separated. Two of the four years were spent in the European theatre where he served for a time as a pilot in Troop Carrier Command. He earned seven different decorations while in the service.

Re-entering the University of Texas in 1945, he spent four years in the Chemical Engineering department, the last two as student assistant.

In his new assignment Bob will pay particular attention to matters of maintenance of plant, following a suggestion made to PETROLEUM REFINER by a group of refining and natural gasoline men who were guests of PETROLEUM REFINER at its 1951 Editorial Conference. The "How To Do It" section also will be in his charge.

The Methodist church at Baytown will miss "Bob" Phillips, who has been its Sunday school superintendent, a member of the board of stewards and a member of the board of education. He also has served three years as scoutmaster.

W. A. Cunningham

M. A. Vela

O. R. Mitchell

R. S. Fairall

L. A. Meckler

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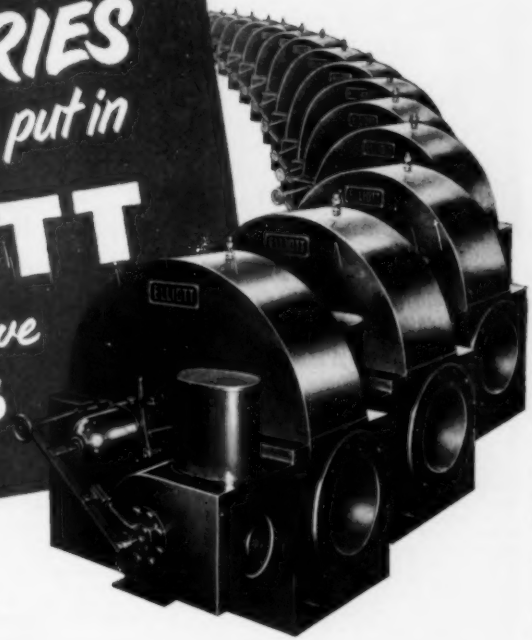

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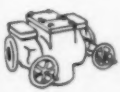

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H2-2

F. Palmqvist F. Sager C. L. Wilson R. L. Lane B. J. Thompson

Exuberance Of Youth Overcame L. A. Mekler

(Photos on Page 150)

No newcomer to the pages of PR, L. A. Mekler, ("Evaluation of Radiant Heat Absorption Rates in Tubular Heaters") on page 101, has a string of over 35 publications in various journals to his credit with his last appearance in these pages coming in 1947. His first time out in print took place in 1922 with a piece entitled "Thermal Problems of Petroleum Refining" when, he says, "in the exuberance of youth I solved all of them." Backed up with 32 years of experience in petroleum refining and other thermophysical and thermochemical industries, Mekler holds over 80 patents on petroleum refining process and equipment. He holds a Candidate of Commerce degree from Harbin Manchuria, a B.A. from the University of Glasgow and a B.S. from the University of California. "Hobby" to Mekler means photographing landscapes, particularly clouds and reflections.

Richard S. Fairall is Mekler's co-author whom he describes as "a brilliant young fellow, quite a photographer, skier and swimmer." Fairall served in the Navy from 1945 to 1946, received his B.S. in mechanical engineering from California Institute of Technology in 1950 and his M.S. from Stanford in 1951. While in Stanford, he was research assistant on a Navy project on heat transfer and worked with Professor London on the free piston engine. While at Cal Tech he spent two summers as a sailor on freighters, won a varsity letter in soccer and swimming, represented Cal Tech at the student conference of the A.S.M.E. and according to his own words "will be best remembered for establishing a record of drinking a bottle of beer in 4.6 seconds."

Development of Acid Treatment Described

The article on page 139, "Lube Oil Acid Treatment Developed for Italian Refineries," was written by two men employed by the Separator-Nobel Company of Stockholm, Sweden, F. Sager and F. T. E. Palmqvist.

Sager is a naturalized Swedish subject, born in Austria in 1903. He studied at the Technical University of Vienna and received a chemical engineering degree in 1925. While a student, he worked during vacations at Shell's refinery in Vienna, and his first job as an engineer was at Astra Romana (Shell) in Ploesti, Roumania, first at the laboratory and then on the first European cracking plant (Dubbs). From 1927 to 1932, Sager was with Universal Oil Products Company in Chicago. In 1932 he joined Separator-Nobel in charge of developing new methods for treatment of cracked gasoline and similar products. He was later promoted to chief technologist of that company and since 1949 has been managing director. Sager's outside interests lie in languages, and he has mastered six, including English, Swedish, French, Italian and Roumanian.

Palmqvist a Gardener

Palmqvist was rather modest when it came to supplying us with biographical information. He forwarded the following: "F. T. E. Palmqvist, born 1915, studied chemistry in Stockholm. Since 1937 have been employed as a research chemist with the Separator-Nobel Company of Stockholm." A penciled notation added: "Hobbies: gardening."

Montana Engineer Is Grinding Telescope

From way out West in a section where the rodeo hands roar: "Powder River and let 'er buck!" Charles L. Wilson reminds us Montana is still on the map as he publishes his article, "The Solution of Multicomponent Phase Equilibria Problems" beginning on page 131. Stationed at Billings, as a process engineer for The Carter Oil Company, Wilson has developed a keen interest in astronomy, to the extent that he is now grinding a ten-inch Pyrex mirror into a reflecting telescope. His other principal interest is petroleum technomics.

Wilson and his wife have populated their domicile with three sons, and have been with Carter Oil since 1941 in the production and manufacturing departments. A 1942 graduate of Oklahoma A. & M. in chemical engineering, Wilson received his M.S. in petroleum engineering in 1948 from Tulsa University where he held a F. G. Cottrell Research Fellowship under Fr. F. T. Gardner.

He maintains active membership in Phi Lambda Upsilon and the Billings Engineers Club.

Solution for Plant Problems Proposed

Those solutions to absorption plant problems proposed in "Have You Solved These Absorption Plant Problems?" by R. L. Lane and B. J. Thompson on page 120 are the result of many years of practical answer-finding by the authors. A native of Arkansas, Thompson is currently a process engineer with Warren Petroleum Company in Tulsa. For three and a half years after receiving his B.S. degree in chemical engineering from Oklahoma A & M College, he was employed by Phillips Petroleum Company in the Texas Panhandle as a junior manufacturing engineer. Transferred to the general offices at Bartlesville, Okla., he wound up the final portion of his seven years with Phillips as a manufacturing engineer. After a stint with Stanolind Oil and Gas Company, he joined Warren four years ago in the manufacturing department.

R. L. Lane joined Sinclair Prairie Oil & Gas Company in 1928, and was assistant chief engineer at the time he resigned in July of 1942 to go with Chemical Construction Corporation. He joined Warren's engineering staff in 1943 in time to help with the construction of the Houston Products pipe line in Texas, the corporation's Norsworthy terminal addition, and the development of the design for the Holliday, Texas, natural gasoline plant.

Ivey Likes The Land; Veltman Sails The Sea

(Photos on Page 154)

The two men who co-authored "Progress Made in Design of Catalyst Activity Test Units" on page 93, turn in different directions for their relaxation after the mental gymnastics required of them by their work.

F. Emerson Ivey is an avid camper, and in the past has been actively interested in Boy Scout counseling work. On the other hand, P. L. Veltman and family share a fundamental interest in the Chesapeake Bay. "Every opportunity we have we sail on the Bay. We have a daughter, Julia Ann, now 10 years old, and a son, John, just past seven. Both children are typical hellions and 'ac-

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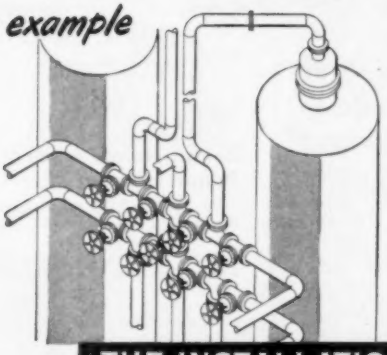

THE INSTALLATION

Nine Crane valves on control manifold to reaction chambers on Perco Cycloversion Unit. Bareco Oil Company, Wichita, Kansas.

VALVE SERVICE RATINGS

SUITABILITY:	Matches service needs
MAINTENANCE COST:	None to date
CORROSION-RESISTANCE:	O.K.
SERVICE LIFE:	Now more than 2 yrs.
OPERATING RESULTS:	Valve leakage stopped
PRICE:	In line
AVAILABILITY:	Local Crane supplier

THE HISTORY

Valves formerly used would not stay absolutely tight as necessary. Down time for repairs was excessive. Fluids handled: At oil inlet, straight run gasoline at 950 Deg. F., 85 psi; for catalyst regeneration, air-steam mixture at 850 Deg. F., 15 psi; regeneration waste gases, 1200 Deg. F. at 5 psi. Approximately 15-day cyclic operation.

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C. W. Shelley

Cliff Rackley

complished sailors,' " Veltman says.

Ivey, who also employs his spare time with cabinetmaking, music and hydroponics—the science of growing plants without the use of earth, has been a Catalyst engineer with The Davison Chemical Corporation since 1948. Prior to that, he was an engineer in the Technical Service division of the Gulf Oil Corporation's Philadelphia refinery.

Born in Bethlehem, Pa., in 1920, Ivey received his B.S. degree in chemical engineering from Lehigh University in 1942 and immediately joined Gulf. In 1945 he served on a Catalytic Cracking Subcommittee of the Technical Advisory Committee to PIWC. He is married and has two children.

Veltman was born in Grand Rapids, Mich., attended Michigan College of Mining and Technology, graduated in 1934. By 1938 he had received his doctorate from the University of Wisconsin. He married the same year and joined the Texas Company at the research laboratories in Beacon, N. Y. where he later became assistant director of fuels research, working on the development of new motor fuels and catalysts. In 1943 he was called by the Atomic Energy Commission to work at the Los Alamos laboratories as the plant engineer for the production and purification of fissionable materials. At the termination of the war in 1945, he joined The Davison Chemical Corporation.

J. W. Young Writes On Suspended Viscometer

The man who is in charge of the petroleum engineering laboratory for Imperial Oil Limited, J. W. Young, turned out "Variable Head Suspended Level Viscometer" on page 145. Currently Young's title reads "Chief Research Engineer, Western Producing Department" of Imperial Oil, but during the past few years he has also served as assistant field superintendent for the Madison Natural Gas Company and as a major in the Royal Canadian Engineers. His military service began in 1941 and lasted through 1945. During that period he served eight months with the American Chemical Warfare Service on the staff of General E. F. Bullene. Young says his spare time is spent in his workshop or working with photography.

Rackley, Shelley Are Authors and Golfers As Well as Engineers

C. W. Rackley and C. W. Shelley, two process engineers at Magnolia Petroleum Company's Beaumont refinery who teamed up to produce "Bench Scale Cracking Unit Capable of Reproducing Plant Conditions" on page 89, not only share the same initials and a deep interest in catalytic processes, but also are old hands around the golf course. Shelley, after 15 years at the game, admits he still "shoots in the low hundreds." Rackley, on the other hand, modestly skips over his golfing statistics, and points out that golf is second choice in his relaxation; hunting is his favorite. Rackley is a native Georgian, coming to Magnolia in 1949 after receiving a degree in chemical engineering from Georgia Tech. During World War II, he served for three years as a bomber pilot in Europe. His home life is shared with his wife and six-year old daughter. C. W. Shelley has a record of 16 years service with Magnolia, working most of the time on catalytic processes. A native of Bell county, Texas, he attended Texas A & M. He is married and has two daughters, ages 15 and eight.

M. G. Farrar Presented LPGA Distinguished Service Award

Mercer G. Farrar, chief engineer of the Pyrofax Gas Company, a division of Union Carbide and Carbon Corporation, has been presented the distinguished service award of the Liquefied Petroleum Gas Association at the organization's annual convention and trade show in Chicago recently. The award is given once each year for outstanding contributions to the association and the LP-Gas industry. It carries with it an honorary life membership in LPGA. Farrar, who is 65 years old, received the award because of his "long and meritorious service to the industry in the development of technical standards and promotion of safety." He has been associated with the Pyrofax Gas Company since 1924.

The convention and trade show broke all previous records both in attendance and number of exhibits and attracted some 2500 persons. Principal speakers at the convention included Senator Richard M. Nixon of California and Richard P. Walsh, director of the Natural Gas Production and Processing division, Petroleum Administration for Defense.

Howard Named Senior Monsanto Research Man at Texas City

Dr. Walter B. Howard, formerly with the Bureau of Industrial Chemistry of the University of Texas, has been named senior research engineer at Monsanto Chemical Company's Texas City, Texas, plant. He holds a Ph. D. in chemical engineering from the University of Texas received in 1943 and is a member of the American Chemical Society and the American Institute of Chemical Engineers.

Howard

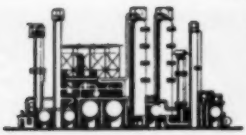
While at the Bureau of Industrial Chemistry at the University of Texas, Howard worked with Dr. E. P. Schoch from 1939 up until the time he resigned to move to Texas City.

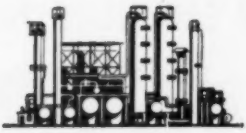
Warren Elected Chairman of Warren Petroleum Corporation

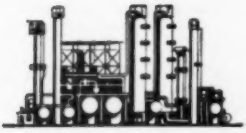
Warren Petroleum Corporation's board of directors have elected W. K. Warren chairman of the board and chief executive officer, J. A. LaFortune, vice chairman; James E. Allison, president, and D. L. Connelly, a vice president and director.

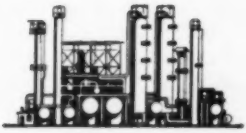
Warren has been president of the company continuously since he founded it on March 15, 1922. LaFortune joined the company as secretary in 1924, became a vice president in 1929 and executive vice president in 1943. Allison has been a vice president, general counsel and director since 1946, having joined the Warren organization at the time it acquired the Hanlon companies of which Allison had been counsel since 1937.

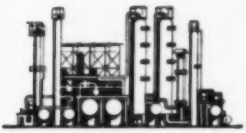
Connelly joined the Warren organization in 1944 as manager of its oil operations in Texas. He has been president and a director of Warren Oil Corporation, a wholly owned subsidiary, since 1948.

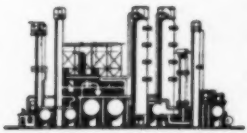


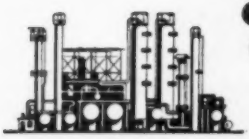












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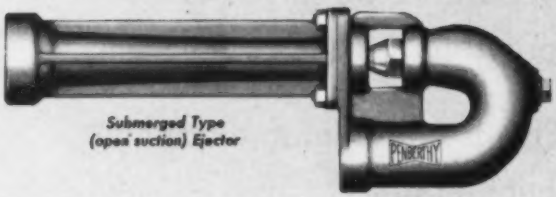

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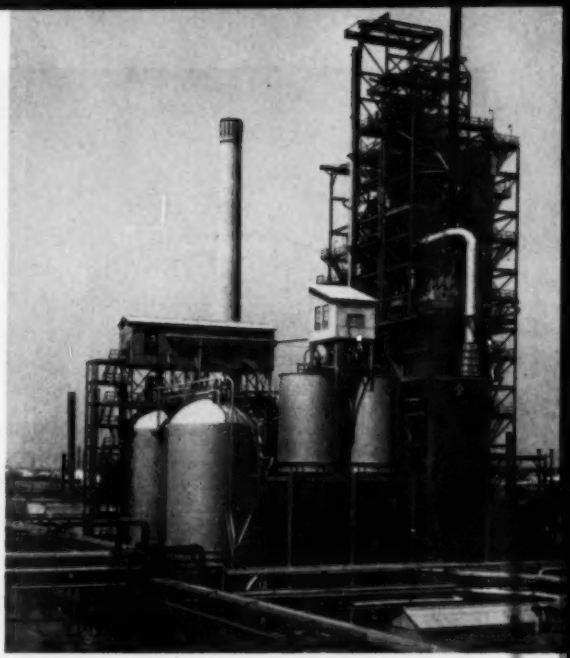


BIRTHDAY — Ten years ago May 25, this catalytic cracking plant, the first of its kind in the world, went into commercial operation at the Baton Rouge refinery of Esso Standard Oil Company. See item below.

PAD Reports On Large Lube Refining Capacity Boost

U. S. lube oil refining capacity was 10.9 percent greater on January 1, 1951, than on the corresponding date in 1950. The estimated capacity on January 1 of this year was 9.4 percent above the total a year earlier.

This and other information regarding lube oil production was released recently the Petroleum Administration for Defense after final tabulations were completed on a survey made in mid-1951. Capacity figures on January 1, 1952, was estimated at 171,175 barrels daily, compared with 161,148 barrels daily on January 1, 1951, and 149,261 barrels per day on that date in 1950.

The survey also gave breakdowns on the end uses of lube oils for 1950 and the first quarter of 1951. The latter tabulation shows that automotive uses of all types of lube oils comprised 27.8 percent of all consumption. Industrial oils other than grease accounted for 18.6 percent of the total, with other as follows: aviation, 1.2 percent; railroads, 2.8 percent; grease, 3.1 percent and "other uses," 0.7 percent.

The survey showed that industrial uses were concentrated in oils with a viscosity index of 76 or below, that automotive uses dominated the 76-95 range and above v. i., whereas aviation uses were almost entirely in the above 95 v. i. category.

Exports amounted to 20.2 percent of U. S. production and bulk sales reached 25.6 percent.

All Floor Space Sold For Chicago Chemical Exposition

All the floor space originally plotted for the National Chemical Exposition in the Chicago Coliseum September 9 to 13 has been sold and efforts are being made to set up extra booths to take care of late applicants.

About 52 percent of the space will be allotted to manufacturers of equipment, 17 percent apparatus supply houses, about 25 percent chemical and the remainder composed of publishers, societies, consultants and others. Nearly 250 exhibitors will be represented.

Oil Black Division Set Up

Witco Chemicals has organized an Oil Black Division which includes the Continental Carbon Company plant in Sunray, Texas, and the Continental Oil Black plant in Westlake, La. J. H. Wishnick and R. A. Reinke have been appointed manager and general superintendent respectively of the new division.

Tenth Anniversary of First Fluid Catalytic Cracker

The world's first commercial fluid catalytic cracking unit (see photo above) on May 25 completed 10 years of operation. This unit is located at the Baton Rouge refinery of Esso Standard Oil Company.

The unit was designed to process 13,300 barrels per day of gas oil but within a period of 10 days was operating above design capacity. This rapid increase in thruput is typical of the history of the unit, and today's operation is at 32,000 barrels per day, 240 percent of the original design.

The Baton Rouge No. 1 unit has proven the way for a long list of other Fluid units which vary in capacity from about 2000 to 60,000 barrels per day. Construction of the Baton Rouge Nos. 2 and 3 units followed closely that of No. 1 and they were put in operation in 1943. The capacities of these units have been progressively increased by bottleneck removal to values far above the original design of 15,500 barrels per stream day. On May 4, 1952, the No. 2 cracker was fed 56,600 barrels of oil, the highest rate for any of the Baton Rouge units. The No. 3 unit on April 28 completed a run of two years and 40 days in which 35,050,000 barrels of gas oil were processed at an average rate of 45,500 barrels per day.

The No. 1 unit resulted from research, development and engineering by the Standard Oil Development Company, research affiliate of Standard Oil Company (New Jersey).

Wulff Acetylene, Ethylene Process Licensed By Firms

The Wulff Process Company has entered into agreements with The Lummus Company of New York, The Fluor Corporation, Ltd. of Los Angeles and Girdler Corporation of Louisville, under which these companies are authorized to design and construct plants for applications of the Wulff process for making acetylene and ethylene.

Wulff has been operating a commercial size pilot plant in Maywood, Calif., for the past 18 months, and during the last nine months the plant has been in continuous commercial production of acetylene. Wulff is now prepared to license the process for large scale commercial use.

The process uses natural gas, ethane, propane, butane, or any LPG mixture as feed stock and produces low-cost acetylene. It may be applied to plants making as little as one ton per day or as much as 100 tons per day. The process is also applicable to the production of ethylene or simultaneous production of acetylene and ethylene.

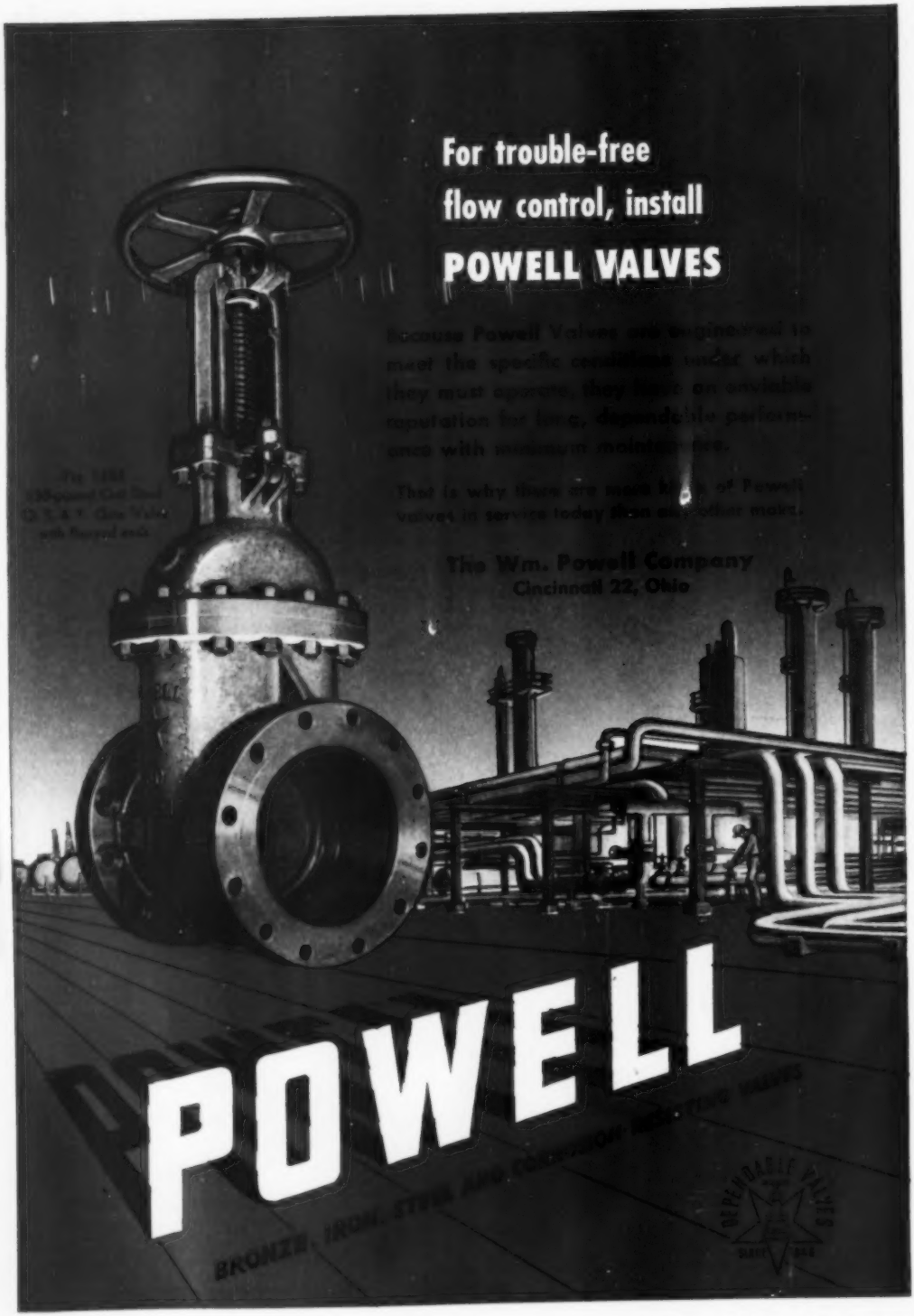
Jersey Standard President Sees Demand Up Seven Percent

The over-all demand during 1952, domestic and foreign excluding Russia, will be about seven percent, or in excess of 750,000 barrels per day, above 1951 averages, Eugene Holman, president of Standard Oil Company (New Jersey), predicted recently. This means about four million tons of steel will be needed for new equipment, and a new capital investment by the industry of more than $3 billion, he pointed out.

Capital expenditures by Jersey affiliates this year are expected to be highest in history, he said. Assuming more realistic policies of material and price control, Holman said, he has "every confidence industry will continue to do its job in stride."

Sinclair Names J. E. Dyer Refining Vice President

J. E. Dyer, director of transportation, supply and distribution for Sinclair Refining Company, has been named vice president and director of marketing succeeding Ernest L. Hughes, who will


For trouble-free
flow control, install
POWELL VALVES
The Wm. Powell Company
Cincinnati 22, Ohio
POWELL

The Month...

become director of property acquisitions with headquarters in Chicago.

M. F. Braeckel, vice president, has been appointed manager of wholesale marketing, succeeding Harry H. Fuller, who will continue as vice president in an advisory capacity. Brown L. Meece, vice president in charge of marketing of the company's western division, will have charge of wholesale sales in that division.

Youell Named Vice President By Stone & Webster Company

The appointment of Leonard L. Youell as a vice president has been announced by Stone & Webster Canada, Ltd. A native of Aylmer, Ontario, Youell graduated from the University of Toronto, served in World War I and worked in both Canada and the United States prior to joining Stone & Webster in 1945. Since the formation of Stone & Webster Canada, Ltd. in 1950, he has been manager of its head office in Toronto. Youell is a member of the Association of Professional Engineers of Ontario, the Engineering Institute of Canada, and the American Society of Mechanical Engineers.

Youell

Wilson Tells Stockholders Business in Big Squeeze

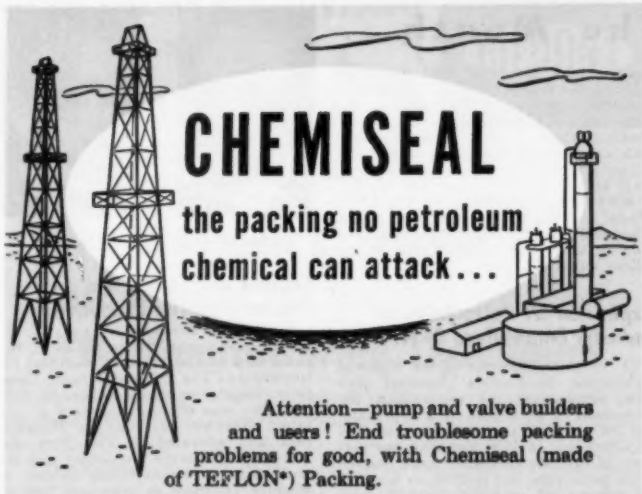
Dr. Robert E. Wilson, chairman of the board, told Standard Oil Company (Indiana) stockholders at their recent annual meeting that, "This is the year when business is caught in a big squeeze at the hands of the government."

It operates in two ways, he said: 1) By holding down prices while promoting substantial wage increases, and 2) By high taxes. As to the first item, he continued, the whole wage-price control program was represented to the public to be essentially a hold-the-line program on both wages and prices. There were assurances that if costs rose in spite of this, prices and wages would be held in fair relationship.

"You know how far actual practice has deviated from these fair promises. The executive branch of the government has actually promoted large wage increases, and even the union shop, which is the greatest threat to the individual liberty of the working man that we have seen since slavery. On the other hand, in fixing prices it has practically disregarded cost increases, and has instead tried to enforce some sort of profit control set up by bureaucratic fiat on the ridiculous basis of 85 percent of the relatively depressed pre-Korea levels.

PAD Predicts Climb in LPG Demands During Next Year

The Petroleum Administration for Defense has predicted demands for liquefied petroleum gas will be about 5.8 billion gallons next year, an 800-million-gallon



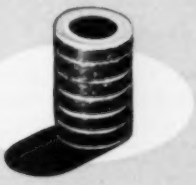
CHEMISEAL

the packing no petroleum chemical can attack...

Attention—pump and valve builders and users! End troublesome packing problems for good, with Chemiseal (made of TEFLON*) Packing.

Chemically inert, there is no need to change packing for different crudes or operating conditions.

Chemiseal is also highly resistant to abrasion, is serviceable from —110°F. to 500°F., stands up where other packings fail rapidly.



Chemiseal Valve Packing No. 810-V provides necessary seal at low gland pressure, reducing torque required to operate valve. Supplied in quantity or in sets with square-end Teflon adaptors. Write for catalogs Nos. 711 and 810-V.

Chemiseal Pump Packing No. 711, for rotating or reciprocating shafts, provides a low-friction, 2-way seal that not only prevents axial seepage, but seals against shaft and stuffing box as well. Sets supplied for specific requirements.

UNITED STATES GASKET COMPANY

FLUOROCARBON PRODUCTS DIVISION

FABRICATORS OF TEFLON, KEL-F AND OTHER FLUOROCARBON PLASTICS

CAMDEN 1, NEW JERSEY

*duPont's trademark for its tetrafluoroethylene resin

The Month...

increase over estimated 1952 demands. Richard G. Walsh, PAD's natural gas production and processing division director, said if the production rate of the product, which is used interchangeably with natural gas, continues at the 471 milion gallons produced last January, there will be more than enough supplies to meet the demand this year. The PAD official also pointed out that new plants scheduled for 1952 completion will provide an additional LPG output of one billion gallons a year.

Expansion Of Petrochemical Industry Emphasized By NPA

O. V. Tracy, director of the National Production Authority's Chemical division, emphasized the tremendous development of petroleum as a raw material for chemical production recently by recalling that in 1930 less than one percent of organic chemicals were derived from petroleum, but in 1950, as much as 60 percent of organic chemicals produced were directly or indirectly from that source.

He pointed to petroleum uses in production of synthetic rubber and synthetic alcohol as examples of expansion, and said more uses could be expected because petroleum raw materials generally were much less expensive than other basic raw ingredients used in making chemicals.

Hartman Named Technical Director For So-Vac Plant

Ben F. Hartman, assistant manager of the process promotion division, Socony-Vacuum Laboratories, New York, has been named technical director for the company's Augusta, Kan., refinery. Hartman will fill the position of the late Emory Skinner. A native of Beloit, Kan., he was graduated from Kansas State College in 1930 with a B.S. degree in chemical engineering. He joined Socony-Vacuum as a chemical engineer at the Augusta refinery in 1937, and was transferred to the New York office in 1951. In his new position he will have charge of the refinery's engineering and laboratory operations.

Stroud

Supplee

Supplee and Stroud Are Elected Atlantic Executives

Henderson Supplee, Jr. and W. F. Stroud have recently been elected to the posts of president and vice president respectively of The Atlantic Refining Company. Supplee succeeds Robert H. Colley, who was elected chairman of the board. Supplee was born in Philadelphia and educated at The Episcopal Academy. Princeton University and the University of Pennsylvania School of Finance. He came to Atlantic in 1947 as vice president and general manager of domestic sales. In 1948 he was elected to the board and in May, 1949, was named executive vice president.

Stroud, in addition to becoming vice president of the company, was appointed general manager of manufacturing. In this position he will be in charge of all manufacturing activities of the company and responsible for the purchase of crude oil required by the refineries to supplement Atlantic's own production. Stroud started with Atlantic in 1916. He became assistant plant manager of the refinery in 1925 and manager in 1945. He is a graduate of New York University and succeeds E. J. Henry, who, after 47 years of service with the company, has withdrawn from active functional management.

W-K-M Manager Dies in Houston

Fred McManis, 74, manager of the W-K-M Company of Houston, died recently at his home in Houston. He was one of the original founders of the W-K-M Company in 1919 and has ever since been active in the management of the company. McManis is survived by his widow, one son, Fred McManis, Jr. of Houston and a niece.

THE OIL MAN'S CALENDAR

JUNE 2- 4	Instrumentation for the Process Industries Symposium, Engineering, Chemical Engineering Departments, A & M College, College Station, Texas.
12-13	Western Petroleum Refiners Assn., Regional Technical and Industrial Relations Meeting, Broadview Hotel, Wichita, Kan.
23-27	ASTM Annual, Exhibit of Testing Apparatus and Laboratory Supplies, New York, Hotels Statler, New Yorker.
AUG. 25-27	Twelfth Annual Appalachian Gas Measurement Short Course, West Virginia University, Morganstown, W. Va.
SEPT. 8-12	ISA Conference and Exhibit, Cleveland, Cleveland Auditorium.
10-12	National Petroleum Assn., Annual, Atlantic City, The Traymore.
14-19	ACS, National (Petroleum Division), Atlantic City, The Traymore Hotel.
25-26	Western Petroleum Refiners Assn., Regional Meeting, Hotel Henning, Casper, Wyo.
OCT. 1- 3	South Central Region, National Assn. Corrosion Engineers, New Orleans, La., Jung Hotel.
6	Independent Natural Gas Association of America, Annual Meeting, Fontenelle Hotel, Omaha, Neb.
9-10	California Natural Gasoline Assn., Annual, Los Angeles, The Ambassador.
13-15	Texas Mid-Continent Oil and Gas Association, Thirty-Third Annual Meeting, Hotel Texas, Ft. Worth, Texas.
20-24	National Safety Council, National Safety Congress and Exposition, Chicago, Conrad Hilton Hotel.
Wk. of Oct. 27	AGA Annual, Atlantic City, Auditorium.
NOV. 10-13	API Annual, Chicago, Conrad Hilton Hotel and Palmer House.
DEC. 7-10	AIChE, Annual, Cleveland, Hotels Cleveland and Carter.

Multiple Executive Changes Announced By Sunray Oil

The Sunray Oil Corporation has announced multiple executive changes involving F. B. Parriott, C. H. Wright, W. C. Whaley, F. L. Martin, L. W. Bennett, and W. L Horner. Sunray's new chairman and executive officer is former president C. H. Wright who becomes chairman and chief executive officer with the retirement of the former board chairman F. B. Parriott. Pariott became chairman of the executive committee. W. C. Whaley, former vice president of the company, has been elected the president of the corporation to succeed Wright. Whaley was recently transferred to Tulsa from Los Angeles where he was vice president and manager for the company's California division. Martin has resigned as a director and vice president in charge of the company's refining and pipe lines division to become president of the Suntide Refining Company, a new company organized by Sunray and outside interests to construct and operate a new 25,000-barrel-per-day catalytic refinery recently announced for the Corpus Christi, Texas, area.

Other officers elected by Sunray's board of directors were announced as follows: Edward Howell, vice president and general counsel; Paul E. Taliaferro, vice president and assistant to the president; H. O. Harder, H. W. Manley, R.

Trends of Operations and Changes in Stocks

Figures on crude stocks are from Bureau of Mines weekly reports; all others from American Petroleum Institute weekly reports, which are estimates on Bureau of Mines basis.

(All figures in thousands of barrels—add 000)

Trends in Week Ended	Crude Oil			Gasoline		Gasoil and Distillate		Residual Fuel	
	Production Daily	Runs to Stills Daily	Stocks Week End	Production Weekly	Stocks Week End	Production Weekly	Stocks Week End	Production Weekly	Stocks Week End
1951:									
January 27	6,066	6,483	244,230	21,106	134,628	9,954	63,324	9,905	41,327
February 24	5,954	6,524	237,204	20,815	145,824	10,545	52,590	9,471	39,881
March 31	6,041	6,381	235,956	20,398	150,691	9,365	46,932	9,147	38,578
April 28	6,154	6,336	242,479	19,876	145,987	8,061	47,852	8,747	36,991
May 26	6,163	6,430	246,400	21,102	139,863	8,580	55,120	9,045	38,092
June 30	6,181	6,595	247,299	21,666	136,355	8,542	70,001	9,036	42,046
July 28	6,205	6,396	251,203	21,539	130,518	8,174	81,602	8,858	45,867
August 25	6,220	6,500	252,257	21,502	125,590	8,761	91,092	8,763	47,906
September 29	6,303	6,558	253,519	21,085	122,468	9,124	104,170	8,332	49,014
October 27	6,340	6,461	250,852	22,364	121,069	9,380	109,095	8,433	50,412
November 24	6,232	6,757	260,465	22,181	122,105	9,428	105,693	9,305	48,704
December 29	6,204	6,763	256,437	22,478	133,070	10,522	89,744	9,371	43,751
1952:									
January 26	6,194	6,384	253,186	21,649	143,621	10,391	71,922	9,222	39,957
February 23	6,366	6,599	255,184	21,328	150,900	10,552	59,373	9,024	38,484
March 29	6,402	6,590	256,681	21,837	158,816	9,712	48,537	8,846	36,565
April 26	6,371	6,600	264,781	20,903	155,367	9,236	51,274	9,034	38,526
May 24	*	*	265,813	*	*	*	*	*	*

* API suspended reports during refinery strike.

PETROLEUM CHEMICALS DIVISION
NEWS

June ★ One of a Series of Interest to the Petroleum Industry ★ 1952

CAPITALIST!

Johnny used to be a laborer. Tim still is. Both cut lawns. Both used to use customers' hand mowers. Each could do one big lawn a day for $2.

Tim spent his $2 on movies and candy. Johnny saved some money, borrowed some more, and bought a power mower. Now he can cut 5 lawns a day, and so makes $10. He puts aside $2 a day to pay back his loan, and $1 toward another mower when this one wears out.

He still has $7 where he used to have two, and is helping more people get their lawns cut when they want them. Yet some enemies of business say this shows that Johnny is too big; that he should be limited in the number of people he can serve.

And they would prevent him from setting aside the $1 a day needed to assure continuing customer service. They would even like to force Johnny to share his $7 with Tim—so Tim could enjoy more movies and candy.

Ridiculous? Yes . . . but these same charges and demands are being leveled at *your* business today.

Dr. Rankin Stresses Importance of Safety to Refinery Workers

In a refinery—especially the tetraethyl lead blending area—safety is an important factor contributing to high production efficiency, uniform quality standards and good employee relations.

What's more, "*Safety is a way of life,*" says Dr. Stewart L. Rankin, chief medical advisor to the Du Pont Petroleum Chemicals Division. And Dr. Rankin drives that point home—forcefully and eloquently—to hundreds of refinery workers every month.

Dr. Rankin is a physician by profession and a safety man by avocation. This combination lends weight to the points he makes and interest to his presentations. As a result, he is in constant demand for safety talks before refinery groups.

In 1951, he spoke to 36 groups ranging in size from 15 to 200 people. In 1952, his schedule is even more active and one large group of 400 has already heard his talk.

"The habit of safety," says Dr. Rankin, "has to be practiced when people are on their own; when they are on the job; when driving their car. Such a habit is an individual and personal matter. It is a prescription that is good medicine, and, in this case, the medicine *is* habit forming.

"If people, individually, make a real effort to keep the monster, personal injury, under control, then an important hazard will have been outlawed in American industry."

With this philosophy, Dr. Rankin is constantly stimulating refinery workers to maintain and improve their already high records of industrial safety.

Joseph L. Stecher Responsible for Success of Many TEL Manufacturing Techniques

Back in the early 20's, the beneficial effects of tetraethyl lead as an antiknock agent in gasoline were known to petroleum and automotive engineers. But the product was not yet available in commercial quantities.

Being highly toxic, it presented a difficult as well as hazardous manufacturing problem. When the Du Pont Company was called in, the responsibility for producing and delivering TEL on a commercial scale was assigned to Joseph L. Stecher, a young Du Pont engineer.

JOSEPH L. STECHER—Today, wherever TEL is made, in this country or abroad, it is produced according to the basic engineering process first set up by Joseph L. Stecher and his associates.

With skill, energy and determination, and working with other Du Pont engineers and scientists, Mr. Stecher absorbed the research data and molded it into a practical, large-scale production venture.

OVER

ADVERTISEMENT—Prepared for the Petroleum Chemicals Division of E. I. du Pont de Nemours & Company (Inc.)

DU PONT

PETROLEUM CHEMICALS DIVISION
NEWS

DU PONT

CONTINUED *Stecher*

One of his outstanding accomplishments was building the entire Chambers Works tetraethyl lead B unit in *only 90 days* . . . with details of the construction worked out in his head. In order to get the unit into production with such speed, he later admitted that the blueprints for the job had been drawn after work had been completed.

Utilizing his first design and plans, Mr. Stecher also supervised the construction of three other producing units in the Du Pont Chambers Works TEL area. Later he was placed in charge of the design and construction of the Baton Rouge tetraethyl lead plant.

DESIGNED UNIQUE FEATURES

Many of the engineering and safety features incorporated by Mr. Stecher and his aids in the original design for TEL manufacturing plants were unique and highly advanced for their day. Yet, they have stood the test of time and are still as safe, as practical and as efficient as in 1923.

The safety procedures and regulations set up by Mr. Stecher in 1923, in many cases, are also still the accepted standards for the industry and continue to meet the most rigid health specifications. In addition, Mr. Stecher and his associates were responsible for the modern features which distinguish the operating equipment and auxiliary facilities of Du Pont's TEL manufacturing plants today.

To the refiner, fast, safe deliveries of TEL are just as important as its manufacture, and Mr. Stecher, with the help of the Chambers Works engineering group, developed the safe handling methods for TEL in railroad tank cars.

Throughout his career, Mr. Stecher has actively contributed to the production and distribution of tetraethyl lead antiknock compounds . . . as supervisor of manufacturing, as manager of the Du Pont Tetraethyl Lead Division, and as assistant director of sales for the Petroleum Chemicals Division.

No wonder so many of his associates refer to Du Pont's Joseph L. Stecher as *"Mr. TEL"!*

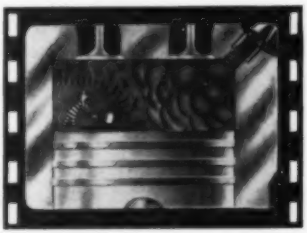
"Pipeline" Wins Award

The Du Pont Petroleum Chemicals Division motion picture "Pipeline on Wheels" has been selected as a co-winner of top honors by the National Committee of Films for Safety in one of its 4 classifications of non-theatrical safety films produced in 1951.

Sound-Slide Film on Gasoline Quality Available to Marketers

Marketers who are interested in visual training aids to improve dealer salesmanship can now take advantage of a new Du Pont sound-slide film presentation.

Adapted from the Du Pont movie, "What Makes a Gasoline Good," this full-color slide film tells the story of how gasoline is made. It's packed with helpful information and concrete selling points, too.



THE ENTERTAINING slide film cartoons show graphically what goes on in a combustion chamber . . . what causes knock . . . and how your high quality gasoline prevents it.

A standardized film strip can be supplied to refiners—free of charge—with personalized beginning and concluding frames bearing their own trade-mark, showing their own stations or pumps, or any other individualized scene. There is no reference to the Du Pont Company anywhere in the film or script.

In cases where it is desirable to amplify the standardized version, the whole presentation can be tailored to suit individual requirements – by inserting any number of slides relating to the refiner's own gasoline brand and special promotions. Even for the personalized versions, the cost is under $5 per print if ordered in quantities of 100 or more.

A sound recording of the script is supplied with the standard version. Where the film is individualized, the recording can generally best be made by the oil company itself. In the latter case, the speaker's delivery can be in keeping with the speech mannerisms of the local marketing area.

CONVENIENT, EASY TO USE

The film is ideal for showing to small groups in the service station. The only requirement is a standard slide film projector which can be conveniently carried in a salesman's car. The equipment can be easily set up on a desk, and anyone can operate it. The running time is only 10 minutes.

To make the message doubly penetrating, give-away cartoon books – retelling the story on the film – can be passed out at each showing. These, imprinted with the refiner's brand or company name, are also available from Du Pont. In small quantities, these are free. A nominal charge is made for the books in lots of 1000 or more.

MANY USES

In addition to dealer education, this Du Pont slide film is ideal for sales promotion work with customer groups, schools and civic organizations.

If you are interested in having one of these slide films made up for your own marketing group, ask your Du Pont Petroleum Chemicals Division representative for full details.

MOVIES AVAILABLE

The following Du Pont films may be borrowed or purchased by oil companies. Address your request to the nearest Petroleum Chemicals Division district office.

Pipeline on Wheels—A 26-minute, full-color movie on tank truck safety. Suitable for both training and public relations purposes.

What Makes a Gasoline Good—An 18-minute cartoon movie in color. Presents, in easy-to-understand form, the story of how high quality gasoline is made. Ideal for dealer training meetings.

DU PONT

Better Things for Better Living
. . . through Chemistry

Petroleum Chemicals

E. I. DU PONT DE NEMOURS & COMPANY (INC.)
Petroleum Chemicals Division • Wilmington 98, Delaware

District Offices: New York, N. Y. · Chicago, Ill. · Tulsa, Okla. · Houston, Texas · Los Angeles, Calif.

District Laboratories: Wilmington, Del. · Chicago, Ill. · Tulsa, Okla. · Houston, Texas · El Monte, Calif.

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A-3547

Printed in U. S. A.

The Month...

E. Foss, M. Darwin Kirk, and W. L. Horner, vice presidents; W. D. Forster, secretary, and L. W. Bennett, treasurer.

Courtney C. Brown Joins Esso Board of Directors

Courtney C. Brown has been elected to the board of directors of the Esso Standard Oil Company. Assistant to the chairman and economic adviser of the Standard Oil Company (New Jersey), Brown will continue to act in these capacities for the parent company, at the same time taking part in Esso Standard's affairs through board membership. After graduating from Dartmouth College, Brown spent 11 years in investment management work in Manhattan. Then he spent two years at Columbia University doing advanced degree work and remained to teach on Columbia's faculty for four years. Early in 1946 he became head of the Petroleum Economics Division of the Jersey company.

Weinrich Made Catalytic Process Section Manager

Whitney Weinrich has been appointed manager of the Process Engineering Section of Catalytic Construction Company and will direct all research and development, pilot plant investigations and process design for the Oil Refinery, Chemical and Atomic Energy projects of the company. Approximately 35 chemists and chemical engineers will be under his supervision. A graduate of Massachusetts Institute of Technology with a Masters degree in chemical engineering in 1931, he has been identified with process development for 20 years. He has been associated with the Gulf Research and Development Company, the Petroleum Administration for War, Phillips Petroleum Company and the Houdry Process Corporation. In the fall of 1950, Weinrich joined Catalytic to direct the process development for an uranium ore refinery under Catalytic's contract with the New York office of the Atomic Energy Commission. He is a member of AIChE and the American Chemical Society.

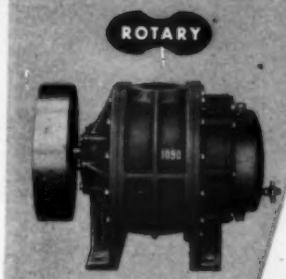
Weinrich

Oklahoma School Conducting Lubrication Research Program

Experiments are currently being conducted on the campus of the University of Oklahoma designed to make lubricating necessary only a few times during the life of the average car. "Recently discovered types of greases, using new and improved materials, are much superior to the products currently in production, but have not been widely used due to their difficulty of manufacture," Professor Walter J. Ewbank of the School of Mechanical Engineering said.

The research program on fuels and lubricants is being conducted on the OU campus under the sponsorship of the

For 10 CFM or 100,000 CFM ...compare blower values



Typical low-capacity R-C Rotary Positive Blower. Sizes range from 5 cfm to 50,000 cfm, permitting selection closely matched to needs.

- ☐ Choice of Rotary or Centrifugal
- ☐ Capacity matched to the job
- ☐ Easy accessibility
- ☐ Ruggedness
- ☐ Ease of installation
- ☐ Ability to handle overloads
- ☐ Long-time durability
- ☐ Freedom from breakdowns
- ☐ Low maintenance costs
- ☐ Engineering assistance
- ☐ Proved reputation of maker
- ☐ Customer satisfaction

No need to take chances when buying blowers, exhausters or gas pumps. Just put this "detector test" to work on your specific problem and you'll arrive at the most satisfactory answer.

For instance, if you're debating between Rotary Positives and Centrifugals, remember that only Roots-Connersville builds both—the exclusive *dual-ability line* that permits unbiased recommendations. Their wide range of capacities supplies sizes and types that are quite likely to be most closely matched to your needs.

For economy of operation, reliability and low maintenance, we refer you to a list of users that dates back almost a century. If you'll rate your possible choices on a performance basis, you'll usually find R-C equipment "tops" on the list.

To help you make the most profitable, practical decision, our experience is at your service.

ROOTS-CONNERSVILLE BLOWER CORPORATION
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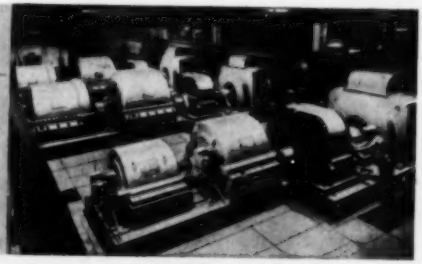
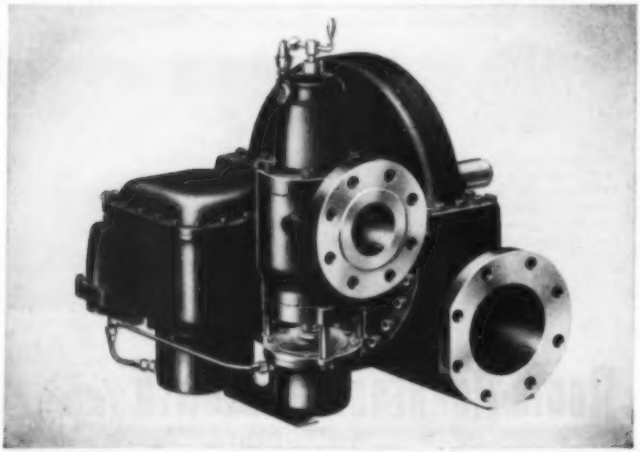
CENTRIFUGAL

Six R-C Multi-Stage Centrifugal Blowers equipped with automatic regulators to provide extremely wide range of operation at various pressures and capacities.



ROOTS-CONNERSVILLE BLOWER
A DIVISION OF DRESSER INDUSTRIES, INC.

Mr. A. Bourgeois, process foreman at Sohio Refinery, adjusts pump valve. Type DP-20, 125 hp turbine increased by 75% the oil thru-put of this pump which supplies crude oil for the distillation unit.



Type DP MECHANICAL-DRIVE TURBINE

This Type DP turbine is one of General Electric's line of mechanical-drive turbines designed for driving pumps, compressors, blowers, etc. Their sturdy construction and many safety features make them ideal for many petroleum industry applications.

At Sohio's Toledo Refinery, this 15 hp, Type DP-16 turbine with non-sparking enclosed overspeed governor, safely pumps propane in an explosive atmosphere.

Mr. Eugene Ten Eyck and Mr. E. J. Bissonnette of Sohio Refinery discuss stocking of interchangeable parts for the Type DP turbines installed at the Refinery.

Sohio Refinery picks G-E turbine drives to increase oil thru-put

Engineers at Sohio's Toledo Refinery installed two G-E mechanical-drive turbines to help eliminate a bottleneck in refinery operations. A General Electric Type DP-20 turbine increased oil thru-put on one pump at Sohio by 75%, when it replaced older drive equipment. Total daily thru-put of the one pump now equals the former capacity of two pumps.

INSTALLED IN HAZARDOUS AREA

Sohio also installed a G-E Type DP-16 turbine in an explosive atmosphere to pump almost pure propane. The enclosed, non-sparking overspeed governor and the positive trip-throttle valve (which shut off all steam flow in case of overspeed) reduce hazards in this area. The turbine, which operates twenty-four hours per day, has required no maintenance during its first year of service.

VIBRATION REDUCED

Replacement of previous drive equipment with a G-E turbine now assures longer life to other machinery in the area. For G-E turbines with their center-line support and rigid assembly of buckets are now contributing to smooth operation at the refinery.

INTERCHANGEABLE PARTS

Use of G-E standard turbines can make stocking of spare parts a simple matter—most replacement parts are interchangeable among various frame sizes of G-E Type DP turbines. Stocking costs are cut, yet parts are available when needed.

This same parts standardization adds to the turbine's flexibility—often the turbine can be adapted to a new plant application with only minor adjustments. Horsepower range can be changed by substituting a different nozzle plate and valve parts.

For more information about the many advantages which these standardized turbines offer the petroleum industry, call in your G-E sales-engineer or write for bulletin GEA-4955A, "A New Standard in Mechanical-drive Turbines." Section 252-56, General Electric Co., Schenectady 5, N. Y.

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The Month...

Morehouse Industries of Los Angeles. New machinery developed by the California Company is being used in the tests. Ewbank believes that through use of the new equipment a better grease can be made available to the car owner.

Also cooperating in the study are the Cato Oil and Grease Company, the Archer-Daniesl-Midland Company and the Foote Mineral Company. The first project under study is the production of lithium hydro stearate greases.

California Standard Plant Begins Using Sumatra Crude

The Richmond, Calif., refinery of Standard Oil Company of California, Commencing June 1, began using the first crude oil to be imported in commercial quantities from Sumatra. This will build up to an average rate of 20,000 barrels daily by August, T. S. Peterson, Standard president said.

Consumption of petroleum products in the western states, plus exports and shipments to the military, was about 1,126,000 barrels daily in 1951—some 37,000 barrels more per day than the available production, Peterson reported.

Shipments of Sumatran crude, he said, should materially offset this discrepancy and also aid the West's oil industry in restoring its depleted above-ground stocks.

Corrosion Meeting Discusses Problems in Atomic Energy

Corrosion problems in atomic energy plants and some "crystal ball gazing" in the field of corrosion were the principal topics of discussion at the Northeast Corrosion Conference held recently in New York City. Under the chairmanship of Kempton H. Roll the conference was jointly sponsored by the Northeast Region and the Metropolitan New York section of National Association of Corrosion Engineers. Dr. J. E. Draley, corrosion specialist of the Argonne National Laboratory stated that the rate of corrosion to be tolerated in atomic energy plants is much less than that permitted in commercial non-nuclear operations. Information presented at the meeting represented a portion of a report being released by the Atomic Energy Commission, containing data on the corrosion resistance of various metals in aqueous solutions at temperatures up to 315° C. Dr. H. H. Uhlig, head of the Corrosion Laboratory at M.I.T. and well-known authority on corrosion looked into his crystal ball in a talk entitled "Corrosion—A Look Into the Future."

API to Publish Booklet On New Motor Oil Designations

The API Lube Committee has authorized a special committee panel to complete an educational booklet, designed to familiarize oil and auto personnel with the new API motor oil service classifications, without further reference to the lube committee. The contents of the booklet are, however, subject to approval of the API president and board of directors.

The committee voted that service classifications and designations be used "verbatim in any API publication, with minor editorial changes in the explana-

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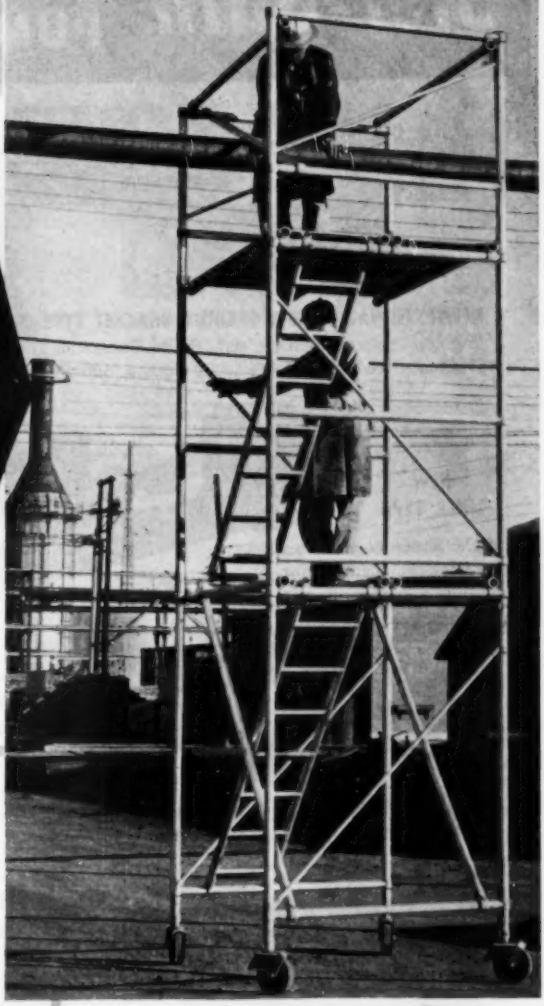
Louisiana Division • Baton Rouge, La.



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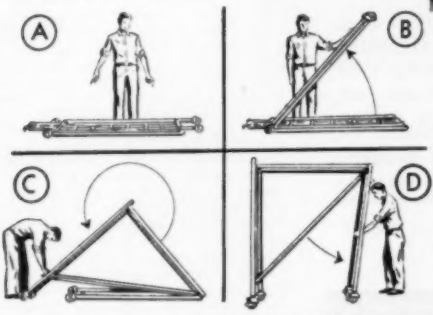

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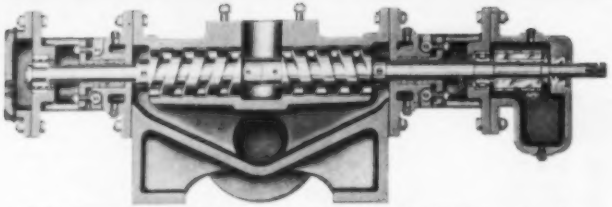
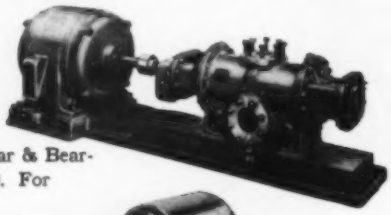
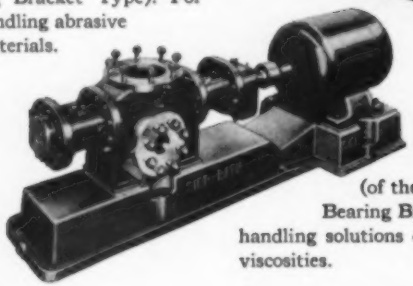


NEW EXTERNAL GEAR & BEARING BRACKET TYPE For handling non-lubricating fluids, semi-fluids. Capacities 1-700 GPM; Discharge 1000 PSI for viscous liquids, 500 PSI for water.



NEW LINER TYPE

(of the External Gear & Bearing Bracket Type). For handling abrasive materials.



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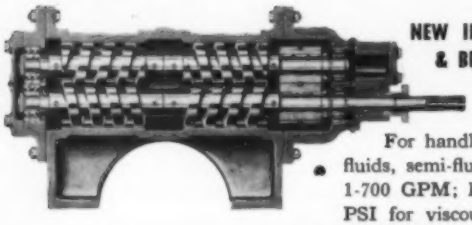
(of the External Gear & Bearing Bracket Type). For handling solutions of extremely high viscosities.



NEW INTERNAL GEAR & BEARING TYPE

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The Month...

tions permitted and with additions permitted if desired." The purpose of the API booklet, when completed, is to provide a pattern which may be followed and to afford smaller oil companies with educational material on the new API motor oil service classifications.

San Francisco API Meeting Tops Attendance Records

Registration at the 17th Mid-Year Meeting of the Division of Refining of the American Petroleum Institute reached the 903 mark, making it the largest mid-year refining meeting to date. The meeting was held at the St. Francis Hotel in San Francisco.

During the four-day meeting, two prominent oil men were honored by the Refining Division with the presentation of API's "Certificate of Appreciation." Recipients of the Certificates were Chester F. Smith, of New York, a director and vice president of the Standard Oil Company (New Jersey), and J. Howard Pew, a director and former president of Sun Oil Company, Philadelphia. Smith was cited for "his calm, dispassionate judgment and clear vision" which "have been steadying influences in the affairs of the Division of Refining."

The Pew Certificate stated: "A dynamic leader, a rugged individualist, and industrial statesman, he has been active in the affairs of the Division of Refining since its organization . . . His devotion to the welfare of the Division has been outstanding."

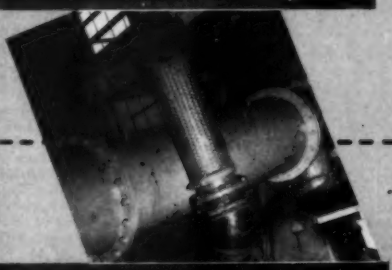
Dr. L. A. Du Bridge, president of California Institute of Technology, speaking before a dinner meeting during the session, said that American industry and the American people must continue to support higher educational institutions to avoid federal subsidies and "bureaucratic control of teaching and research. The choice is before us—and it should not be made by default."

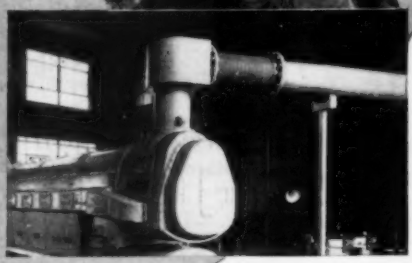
In his appeal for support of higher educational facilities, Dr. Du Bridge said the chief source of income for private institutions will continue to be the individual. If one individual can no longer give $1 million, he continued, then a thousand must be found to give $1000 each. The business corporation, which is an association of people—the stockholders—should also be an important source of help, the educator stated. Industry cannot get along without universities—nor can universities get along without industry, he told the oil men.

Before another meeting, Vance M. Jenkins, research supervisor for the Union Oil Company of California, warned the petroleum industry that it may be faced with additional and perhaps needless expense for the installation of still more air-pollution equipment as a result of a new theory on formation of smog in Los Angeles county.

The alert was sounded in a paper presented by Jenkins at the final session of the meeting. He called attention to the new—and as yet unproved—theory advanced by Dr. A. J. Haagen-Smit of the California Institute of Technology that Los Angeles smog is composed of the reaction products of certain unsaturated hydrocarbons with the oxidant known to be present in the Los Angeles atmosphere in varying conditions. Jenkins cited some objections against Dr. Haagen-Smit's theory and discussed pos-

Large Diameter CMH REX-WELD CORRUGATED FLEXIBLE METAL HOSE





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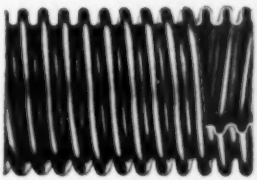
For full information and data sheets see your local CMH distributor—look for his name in your classified telephone directory—or write direct.



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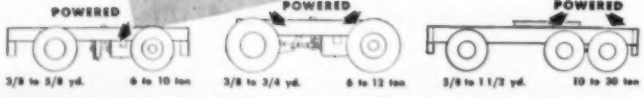

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The Month...

sible sources for the unsaturated hydrocarbons present in the air.

In another paper on atmospheric pollution, three Stanford Research Institute experts, Paul L. Magill, Frederick G. Sawyer and Richard D. Cadle, said the problem of smog control is not one for industry alone but the public as well since the individual citizen is also a polluter of air.

The General Committee of the Division of Refining selected New York City as the site for its 18th Mid-Year Meeting next spring, subject to approval of the Board of Directors. The meeting dates are May 11 to 14, 1953, and the Commodore Hotel has been selected tentatively.

Several of the papers presented at the mid-year meeting can be found in the May issue of PETROLEUM REFINER.

New President Elected By The Institute of Petroleum

At its Annual General Meeting, the Institute of Petroleum in England elected H. S. Gibson president for the 1952-53 term. Gibson is managing director of the Iraq Petroleum Company, Ltd., and associated companies. Previously he was general fields manager in Persia for the Anglo-Iranian Oil Company. In 1949, he returned to England and for a while was in charge of the AIOC research station at Kirklington Hall. He was awarded the Redwood Medal of the Institute of Petroleum in 1947.

Three new vice presidents of the Institute also elected include H. Hyams, Product Development and Research Department of the Shell Petroleum Company, Ltd.; H. E. F. Pracy, general manager of Trimpell, Ltd., and R. B. Southall, director of National Oil Refineries, Ltd.

Pure Oil's Wescoat Heads NPC Storage Study Committee

Chairman Walter S. Hallanan has named L. S. Wescoat, Pure Oil Company president, as chairman of the new National Petroleum Council Petroleum Storage Capacity Committee.

Other committee members are: Paul G. Blazer, Ashland Oil & Refining Company; Horace E. Davenport, Independent Oil Men's Association of New England; B. A. Hardey, Independent producer; Harry B. Hilts, Atlantic Coast Oil Conference; Charles B. Jones, Richfield Oil Company; John M. Lovejoy, Seaboard Oil; Nelson Maynard, National Congress of Petroleum Retailers; L. F. McCollum, Continental Oil; Clarendon E. Streeter, Pennsylvania Grade Crude Oil Association; Reese H. Taylor, Union Oil, and W. W. Vandeveer, Cleveland.

ASME Semi-Annual Meeting To Be Held in Cincinnati

Twenty-one divisions and committees of the American Society of Mechanical Engineers and five engineering societies will participate in the 1952 Semi-Annual meeting of the ASME in Cincinnati, Ohio, June 16-19. A total of 86 papers dealing with almost every field of mechanical engineering will be presented at 38 technical sessions. Headquarters

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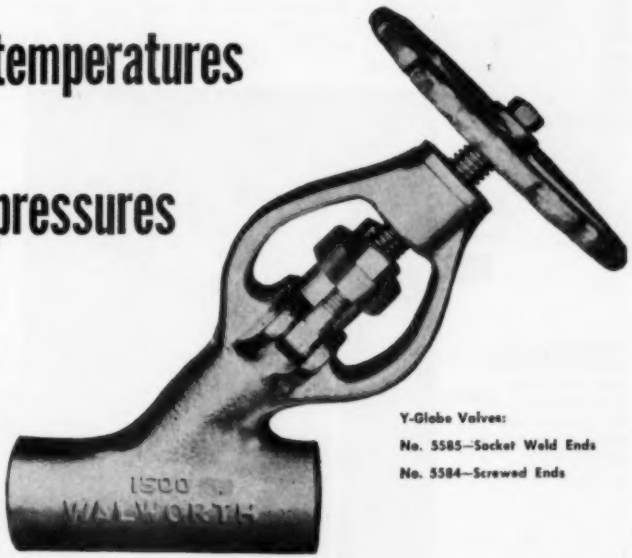

Y-Globe Valves:
No. 5585—Socket Weld Ends
No. 5584—Screwed Ends

Walworth is proud to make these new Small Cast Steel Valves available to power stations . . . oil refineries . . . ships . . . wherever piping is subject to severe pressures and temperatures. Non-shock service ratings of these valves: 1500 psi–950F for steam; 3600 psi–100F for water, oil or gas. Cast of chromium molybdenum steel, they are compact and light, yet exceptionally strong. Both Y-Globe and Angle type valves are available.

Angle Valves:
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Simplified Walworth design eliminates many of the valve problems encountered in high pressure service. Among the features of this new valve are:

INTEGRAL BODY AND YOKE – made from a single casting without threading or welding. Bonnet joint — always a potential source of leakage — is eliminated. Valves can be reassembled quickly and easily.

ROTATING DISC – prevents valve seat distortion and consequent leakage. Cuts down replacements.

WELDED SEAT RING – compensates for changes in pressure and temperature—eliminates a major source of leakage.

SPECIAL BACK SEAT BUSHING – permits repacking the valve under pressure with greater safety.

PACKING CHAMBER – designed to dissipate heat thus keeping packing rings at lower temperatures—gives them longer life.

These valves are available with either socket weld ends or screwed ends, in sizes ranging from ¼ to 2 inches. For further information on Walworth series 1500 Small Cast Steel Valves, see your local Walworth distributor, or write for Circular No. 134.

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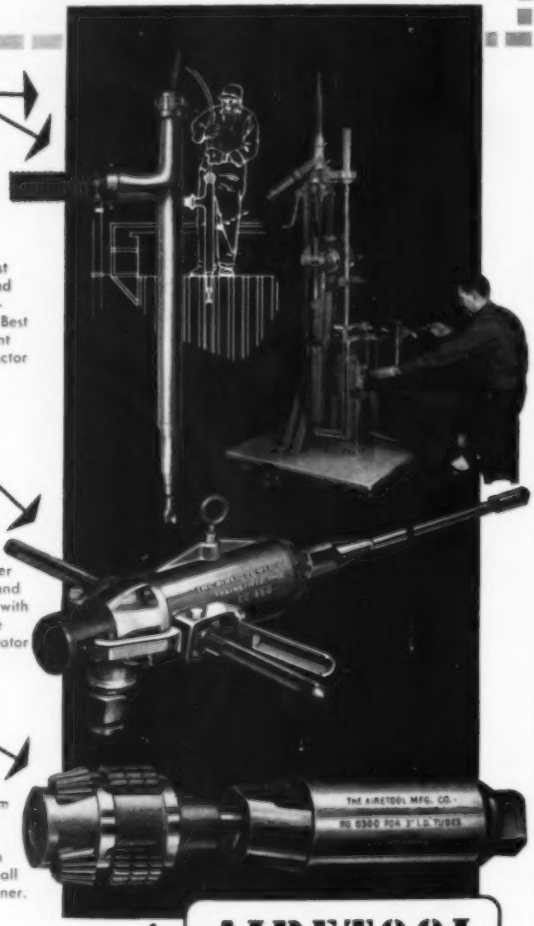

AIRETOOL catalyst cleaners (overhead type, left; ground-level type, right). Best for removing spent catalyst from reactor tower tubes.

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Coke removal from straight furnace tubes is easily accomplished with this AIRETOOL ball bearing type cleaner.

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for the meeting will be the Sheraton-Gibson Hotel. Groups co-sponsoring sessions with ASME are, American Society for Testing Materials, American Society of Lubricating Engineers, Society for the Advancement of Management, American Institute of Industrial Engineers and Engineering Society of Cincinnati.

N. A. C. Smith, Bureau of Mines Chemist, Dies May 19

N. A. C. (Nick) Smith, petroleum chemist with the Petroleum Experiment Station of the Bureau of Mines, Bartlesville, Okla., died May 19. He was graduated from Clark University in 1909 and after nine years in industrial organic chemistry, joined the Bureau in 1918 as an assistant petroleum chemist. He was made superintendent in 1926 and held that post until 1945 when he relinquished it to devote his time to writing. He was an authority on the interpretation of crude oil analyses and was author or co-author of several publications.

Smith

Smith was a charter member of the Petroleum Division of the American Chemical Society, and was active in the formation and early developments of Committee D-2 on petroleum products of the American Society for Testing Materials.

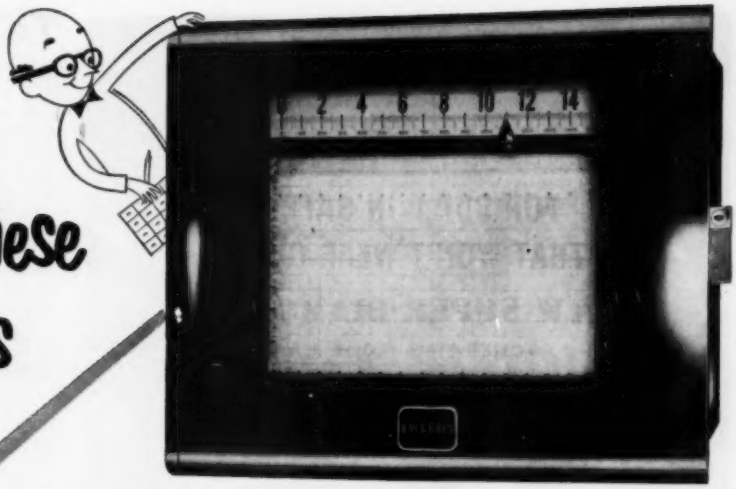
J. Ed Warren Replaces Bruce K. Brown in Deputy PAD Post

J. Ed Warren, independent producer of Midland, Texas, has been sworn in by Interior Secretary Chapman as deputy PAD, replacing Bruce K. Brown of Pan-Am Southern. In paying tribute to Brown, Chapman bestowed the Interior Department's highest tribute, the Distinguished Service Award, upon him and said:

"He initiated, organized, and gave inspiring leadership to a mobilization program under which no defense or essential requirements for petroleum or gas have gone unfulfilled. His wide vision has made possible the adoption of a personnel rotation program under which a continued vigorous life of the Petroleum Administration for Defense as an emergency agency has been assured."

WPRA Holds Second Regional Meeting in Wichita, Kansas

The Western Petroleum Refiners Association will hold their second Regional Technical-Industrial Relations meeting of 1952 in Wichita, Kan., June 12-13. The two-day affair will be highlighted by a tour of the Derby Oil Company's modernized refinery, including an inspection of their new 10,000-barrel-per-day Socony-Vacuum Catalytic Cracking unit. Technical sessions will be designed toward presenting papers which deal with technical and economic aspects of catalytic operations. Included in the Industrial Relations program discussions will be D. R. Blazier, assistant personnel di-



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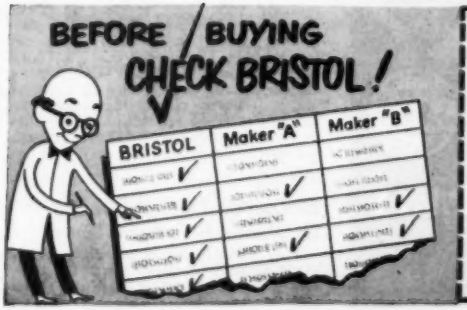

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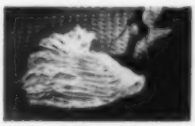

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Over 125 Years of Iron and Steel Making Experience
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The Month...

rector, Mid-Continent Petroleum Corporation, who will discuss the workings of a refinery employe suggestion program and will offer ideas as to how such a program may be made successful. The philosophy of employe relations will be the subject of a talk to be made by LeRoy Wilkie, training supervisor, Humble Oil & Refining Company, Baytown, Texas. He will first show the necessities of having a philosophy, followed by a discussion concerning some practical problems in its development, composition and applications. The Broadview Hotel will serve as headquarters for the meeting.

D. C. Shea Named to Employe Relations Position by Esso

The appointment of Dennis C. Shea as assistant manager of employe relations for manufacturing has been announced by Esso Standard Oil Company. Shea, who joined the company in 1924, was former coordinator of employee relations for the East Coast manufacturing division. A graduate of Catholic University, he served in various engineering posts and in both process and instrument operations before transferring to employe relations in 1935. After serving as personnel manager at both the Bayway and Bayonne refineries, he was named employe relations coordinator for the New Jersey works. Shea is a native of Washington, D. C.

Richard F. Sheehan Named To OIIC Advertising Post

The Oil Industry Information Committee has named Richard F. Sheehan, formerly with the G. M. Basford Company, to the new post of supervisor of advertising to create copy for its advertising program. Sheehan has had 14 years of experience in advertising and sales promotion work, including time with several oil company accounts. In the new post, he will work with OIIC's advertising sub-committee and with the committee's advertising agency.

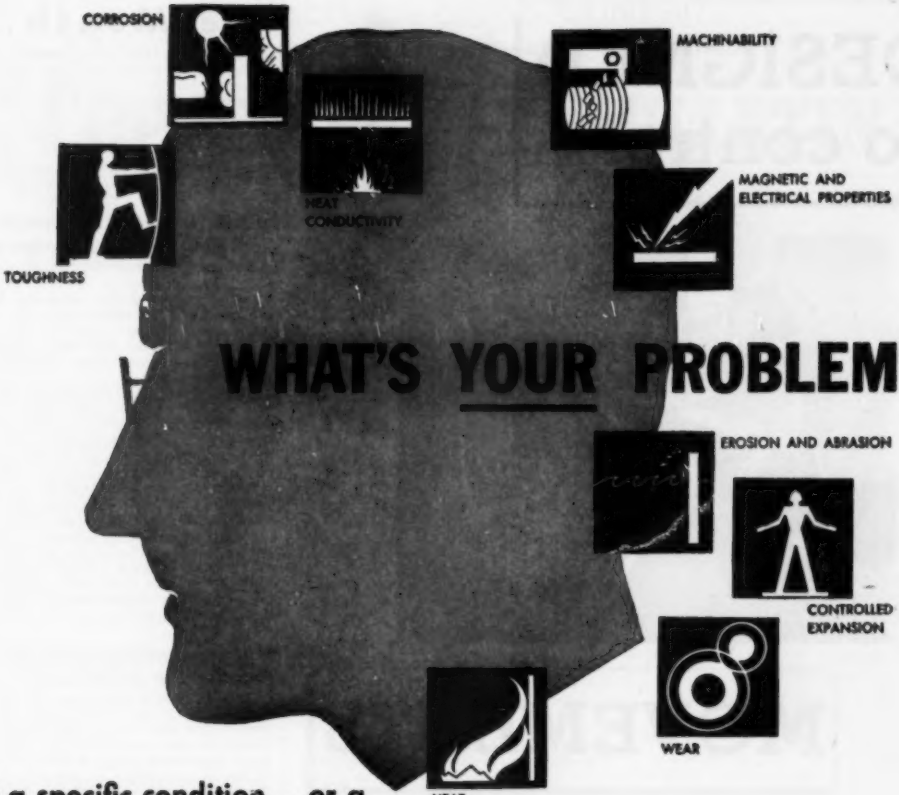
He attended Harrisburg Academy, Trinity University, Dublin, Ireland, and Pace Institute.

Horridge Joins Catalytic As Planning Department Head

Catalytic Construction Company has announced that Don L. Horridge has joined the organization in its Philadelphia engineering office as manager of the planning department. Horridge, until recently was vice president of Tears Engineers of Dallas, Texas, and prior to that association was chief draftsman for Process Engineers, Inc., of Dallas and the Gasoline Plant Construction Corporation of Corpus Christi, Texas. A native of Vermont, Horridge is 38 years old and received his technical education at Southern Methodist University and through numerous special technical courses.

McQuilkin Elected Director Of Standard-Vacuum Board

J. A. McQuilkin, a petroleum marketer in Southeast Asia for a quarter-century, has been elected a director of the Standard-Vacuum Oil Company. He has



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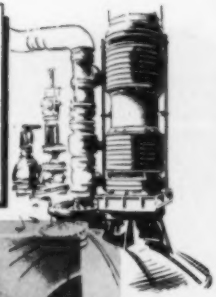

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Badger Expansion Joints safeguard expensive processing equipment. The Badger Tandem Joint shown in installation above is the perfect answer to the need for protection from damage to piping and equipment due to axial and lateral movements. Telescoping sleeves can be provided to withstand abrasive catalysts.

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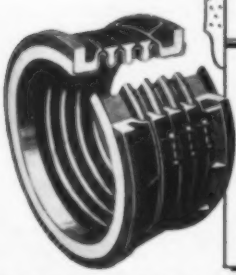

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The Month...

served since 1950 at Stanvac's New York office as deputy manager and later manager for the company's Southeast Asia marketing organization. McQuilkin was born in East Liverpool, Ohio, attended high school in Long Beach, Calif., and was graduated from Princeton University in 1924. He entered the oil business in 1926 as a salesman.

British American Announces Canadian Plant Appointments

The British American Oil Company, Ltd., has announced several appointments in its Canadian refineries. M. T. Stevens has been named manager of its refinery at Clarkson, Ontario. He joined B-A in 1935 and has since managed refineries at Moose Jaw, Calgary and Edmonton.

C. W. Coote has been appointed manager of the Calgary plant after serving during the last four years as assistant manager. R. M. McDonald has been made assistant manager of the refinery. He joined B-A 17 years ago and has served in various capacities at the Moose Jaw and Clarkson refineries. Most recently he was superintendent of the company's Turner Valley absorption plant.

R. T. Watson leaves his post as manager of the Calgary refinery to become manager of the Edmonton plant. He has served 32 years in the company's manufacturing department.

Nation's Refining Capacity Nearing Pre-Strike Levels

The nationwide oil workers strike was virtually at an end by the first days of June following the opening of two Gulf Coast refineries over the Memorial Day week end which dropped the percentage of halted production to about 4 percent. During the peak of the strike, most estimates placed about one-third of the country's total refining capacity at a standstill.

Precipitated over union demands for a 25-cent wage hike, most companies talked increases ranging from 15 to 18 cents per hour. By mid-month, OWIU President, O. A. Knight, said unions would be willing to sign for a 15 cents an hour wage hike which the Wage Stabilization Board had previously announced it would approve automatically. However, a complete halt to the strike hinges on local bargaining results.

Humble Oil Building New Gas Compressor Plant At Pickton

A new gas compressor station and other facilities to process gas from the Pickton Field in northeast Texas and to provide greater recovery of oil are being built by Humble Oil & Refining Company. Humble already operates a gas plant near Pickton, in Hopkins County.

The new installation will be capable of processing an additional 30.6 million cubic feet of gas daily and injecting 28 million cubic feet back into the ground so that more oil may be produced. The project is part of Humble's $40-million postwar program for conserving casinghead gas and increasing oil recovery through the use of it.

Work on the project is already underway and is expected to be completed before the end of the year. Stearns-Roger Manufacturing Company was awarded the construction contract.

BRIDGEPORT BRASS COMPANY

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COPPER ALLOY BULLETIN

"Bridgeport" MILLS IN BRIDGEPORT, CONN. AND INDIANAPOLIS, IND.—IN CANADA: NORANDA COPPER AND BRASS LIMITED, MONTREAL

Reducing Galvanic Corrosion Attack in Sea Water

When two dissimilar metals are brought into electrical contact in an electrolyte, corrosion of the less noble metal (anode) occurs in excess of its normal rates in that electrolyte while the more noble metal (cathode) is protected. This accelerated corrosion is known as galvanic corrosion.

Galvanic action does not occur when dry dissimilar metals are in contact. It is for this reason that iron hangers can be used to support copper and brass pipe. Also numerous mechanical devices made of several dissimilar metals may be successfully used in the absence of water.

Galvanic Corrosion in Salt Water

Solutions of chloride salts are recognized as being very corrosive towards the common metals and alloys and are found in (1) sea water; (2) salt refining; (3) in the manufacture of chlorine, chemicals, soaps, etc.; (4) cooling brines; (5) vegetable sorting brines; (6) crude oil and petroleum products and in numerous other places. Since salt water is so widely used in industrial operations, galvanic corrosion is commonplace because most equipment is generally constructed from many dissimilar metals and alloys.

Galvanic Series Varies With Corrosive Environment

Information obtained on a group of metals, examined under a given set of conditions makes it possible to arrange the metals in a galvanic series.

The following table, showing the differences in behavior of eleven metals in sea water as compared with the Electromotive Series, was obtained by arranging these metals according to their potentials in solutions of their own ions.

Galvanic Series in Sea Water	Electromotive Series
Magnesium	Magnesium
Zinc	Aluminum
Aluminum	Zinc
Cadmium	Iron
Iron	Cadmium
Lead	Nickel
Tin	Tin
Nickel	Lead
Copper	Copper
Silver	Silver
Gold	Gold

However, they do not always follow the same order as given in the Electromotive Series generally published. The order frequently changes very markedly with the corrosive environment.

Galvanic Protection of Copper-base Alloys

Plates of aluminum-base alloys, both with and without copper-base alloy bolts, were immersed in sea water. Within a few months the aluminum showed very slight general corrosion and more intense corrosion localized around the bolts. A similar test, conducted with zinc plates, gave practically the same results. Prolonging the latter test eventually led to a depth of attack sufficient to allow the copper alloy bolts to drop out of the zinc plates. In both instances the copper-base alloys remained intact and showed no signs of corrosion because they had been galvanically protected at the expense of the less noble metals.

Cathodic or Galvanic Protection

Numerous investigations have shown that cathodic protection of metals is feasible. In practice this is accomplished, for example, by the sacrificial protection of iron by zinc, such as galvanized iron (galvanic) or by an imposed potential (cathodic protection) whereby corroding metal is maintained artificially as the cathode. This is applicable only to certain types of structures such as storage tanks, condenser water boxes and the exterior surfaces of pipe lines. This must be done with caution since certain metals may under some conditions be corroded more rapidly by the alkali which normally forms in the cathodic area.

Satisfactory Galvanic Couples

The extremes in potential differences between various copper-base alloys in sea water and in 3% sodium chloride solutions is small, seldom exceeding 0.2 volts. Consequently copper and various copper alloys can be successfully coupled together in such corrosive media. This explains why they are so widely used in salt water services.

The potential difference between dissimilar metals may be unimportant due to the smallness of the exposed area of the more noble member of the galvanic couple. For example, copper alloy bolts fastened in steel plates immersed in sea water do not necessarily lead to increased corrosion of the steel. In such a galvanic couple, the *initial* potential difference between copper and low carbon steel may range from 0.5 to 0.7 volts. This lack of activity is due to stifling of the cathodic reaction on the relatively small surface of the copper alloy bolt head and nut. The stifling is due primarily to deposition of magnesium and calcium carbonate from the sea water on the cathodic surface (copper alloy). This explains why the widespread use of bronze bolts to fasten steel or cast iron parts in marine services has led to no difficulty from galvanic corrosion.

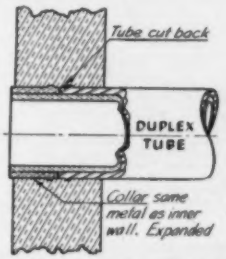

Fig. 1. A common method of protecting Duplex tubing from galvanic corrosion.

Silicon bronze bolts and brazed joints used to fasten together carbon steel sections exposed to sea water have led to no measurable increase in corrosion of the steel because of their small area compared to relatively large carbon steel sections.

Protecting Duplex Tubing

Since Duplex tubes are often made from a combination of steel or aluminum with copper or a copper-base alloy, the problem of galvanic attack between the two different metals, in certain corrosive environments, can be solved in several ways.

Where it is necessary to prevent galvanic action at the tube sheet, a ferrule of the same material as the inside of the Duplex tube is used. One method is shown in Fig. 1.

Consult the Bridgeport Corrosion Laboratory for assistance with your galvanic corrosion problems on condenser and heat exchanger tubing for power refining or process industries.

(8406)

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Expansion Joints Catalog

A catalog describing types of corrugated expansion joints has been released by Flexonics Corporation, formerly the Chicago Metal Hose Corporation. This edition contains specification and installation data for free flexing joints for low pressure application.

Circle No. 1 on Postcard

Steels Durability Data

A booklet entitled "Atmospheric Durability of Steels Containing Nickel and Copper-Additional Exposures Data" has been published by International Nickel Company, Inc., and contains eight charts and tables that review recent data and literature on the effect of nickel on atmospheric corrosion in low alloy high strength steels. Comparisons of results are made for moderate and heavy industrial, marine and rural atmospheres. Beneficial effects of varying nickel and copper and other alloying elements are discussed.

Circle No. 2 on Postcard

Combustion Indicator Data

Another photo-electric relay application, in the form of a Hazegage Combustion Indicator, is described in a bulletin published by Ess Instrument Company. Since the proper ratio of air and fuel is a constant concern to design, plant and operating engineers, the bulletin may prove a handy reference to fuel savings through increased combustion efficiency. Wiring diagrams of installation and relay circuits are included in the bulletin.

Circle No. 3 on Postcard

Ventilating Fan Catalog

Chelsea Fan & Blower Company has issued a catalog, price sheet and engineering bulletin describing 30 fan types and over 300 sizes. Complete specifications, dimensions, installation diagrams and product photographs, as well as extensive information on the proper selection and installation of fans for industrial, commercial and residential requirements are included.

Circle No. 4 on Postcard

Lead Clad Metals Booklet

Because the new lead clad metals are becoming so important in many industries and are solving many design and process problems, Knapp Mill, Inc., has announced the availability of booklet, "The History and Development of Ferroleum Lead Clad Steel and Cupralum Lead Clad Copper," to aid engineers, designers and technicians in understanding their characteristics.

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A7	B7	C7	D7	E7	F7	G7	H7	J7	K7	L7	M7	N7	P7	Q7	R7	S7	T7
A8	B8	C8	D8	E8	F8	G8	H8	J8	K8	L8	M8	N8	P8	Q8	R8	S8	T8
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Name (Please Print)_____

Company_____ Position_____

Address_____

MAIL IT NOW . . . *CARD EXPIRES SEPTEMBER 10, 1952

New Catalogs AND EQUIPMENT LITERATURE

Use one of the free and convenient Reader Service Postcards on this page to request copies of the catalogs in which you are interested.

Variable Area Flow Meters

A handbook has been published by the Fischer & Porter Company to aid in the selection and sizing of variable-area meters. It contains, in condensed form, the results of fifteen year's research by the F & P fluids engineering department. A complete description of variable-area meters, tubes and floats and their comparison with variable-head meters, as well as calibration prediction data has been included.

Circle No. 6 on Postcard

Corrosives Handling Data

A two-year old thermosetting furan coating, known as Carbo-Kote 6020, has been improved in physical characteristics and ease of application and is now described in two new bulletins that present detailed data on corrosion resistance and a new heat resisting primer for steel and concrete. Methods of application, characteristics, hardening time and cost are included along with other pertinent information.

Circle No. 7 on Postcard

Wrought Alloy Parts

A variety of cast and wrought alloy parts used by many industries to solve abrasion, corrosion and high-temperature problems, is described in a new Union Carbide and Carbon Corporation booklet entitled: "Long-Wearing Machinery Parts."

Circle No. 8 on Postcard

Pump Valves, Packings Book

Sims Pump Valve Company, Inc., has made available its latest catalog on pump valves, packings and husheaters which contains complete descriptions, schematic drawings, case histories and installation instructions on the company's complete line.

Circle No. 9 on Postcard

Two-Drum Boilers Bulletin

A bulletin describing its complete line of two-drum boilers has been made available by the Henry Vogt Machine Company outlining the specifications and features of Class VF and VS bent tube boilers. Typical installations throughout the country are reviewed and principal data on each unit included.

Circle No. 10 on Postcard

Condensed Scale Catalog

A 28-page condensation of its complete catalog of scales has been issued by The Howe Scale Company, listing a thousand popular models weighing from 1/64th of an ounce to 400 tons. The catalog includes specifications, essential information and is arranged by types of weight indication. Featured are the Howe scales with beam indication, the tape-drive dial, weightograph projection and the Teleprint electronic remote weight recorder.

Circle No. 11 on Postcard

(More Literature Items on Pages 177, 179, 181, 183)

PETROLEUM REFINER Reader Service Postcard – June, 1952, Issue*

EDITORIAL ITEMS—Circle item numbers on which more information desired:

1	4	7	10	13	16	19	22	25	28	31	34	37	40	43	46
2	5	8	11	14	17	20	23	26	29	32	35	38	41	44	47
3	6	9	12	15	18	21	24	27	30	33	36	39	42	45	48

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A2	B2	C2	D2	E2	F2	G2	H2	J2	K2	L2	M2	N2	P2	Q2	R2	S2	T2
A3	B3	C3	D3	E3	F3	G3	H3	J3	K3	L3	M3	N3	P3	Q3	R3	S3	T3
A4	B4	C4	D4	E4	F4	G4	H4	J4	K4	L4	M4	N4	P4	Q4	R4	S4	T4
A5	B5	C5	D5	E5	F5	G5	H5	J5	K5	L5	M5	N5	P5	Q5	R5	S5	T5
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NEW EQUIPMENT and Manufacturers' Literature

KEEP INFORMED by requesting additional information on new equipment and services described here. SAVE TIME by using the Reader Service Postcards on opposite page. Circle number on card corresponding to the number listed at the end of each new equipment item on which you desire additional information.

Rotary Bulk Plant Meter

A six-inch rotary, positive displacement bulk plant meter, the Rotocycle 6 BLX, has recently been developed by Rockwell Manufacturing Company for liquid accounting of inventory withdrawals of aviation gasoline. The meter may also be used on loading racks for measurement of refined petroleum and in chemical plants, lubricating oil plants and industrial proportioning operations. Aluminum casings are available on the meter to meet the increased demand for large meters of non-ferrous material. It is designed for continuous operation at working pressures up to 125 psi and flow rates up to 650 gpm. Standard accessories available for the meter include strainers, air eliminators, register extensions, swivel adapters and remote registration, and it is available with a variety of registers.

Circle No. 12 on Postcard

Steam Generator Bulletin

A new bulletin No. 2000 especially prepared for engineers, consulting engineers and architects for their guidance in understanding the design features of the Preferred Unit Steam Generator has been announced by Preferred Utilities Manufacturing Corporation. The bulletin describes the engineering differences of the component features of the self-contained Preferred Unit Steam Generator. Cutaway views for visual reference supplement the descriptions. A section is devoted to data and dimensions of the Preferred Unit Steam Generator and a fully described list of standard and accessory equipment. Unit sizes range from 20 hp to 600 hp and pressures up to 250 psi.

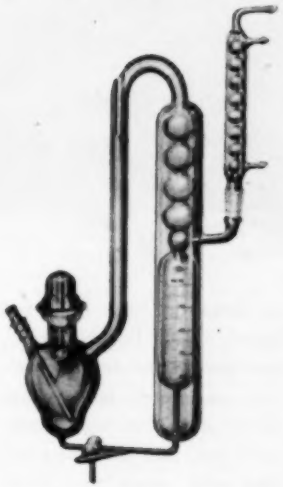
Circle No. 13 on Postcard

Electrical Maintenance Data

Westinghouse Electric Corporation's latest booklet presents a sound maintenance program based on the use of genuine renewal parts, repair service plants, and engineering and field service. Photographs show the special skill, testing devices, and repair equipment which are available to customers through repair plants. Many improved design renewal parts are described to emphasize the importance of obtaining genuine renewal parts. Motor exchange service, periodic inspection service, and "on the spot" repairs by field engineers are also described.

Circle No. 14 on Postcard

Flash Vaporization Still



A new flash vaporization equilibrium still which obtains true equilibrium in an accurate and simple manner has been introduced by the Emil Greiner Company. The new still obtains equilibrium flash vaporization data for petroleum mixtures as easily as determining ordinary boiling point data, it is claimed. This is accomplished by the design of a modified recirculation type Othmer Still and thoroughly evaluated at atmospheric and subatmospheric pressure for equilibrium conditions, entrainment and pressure drop. The still always obtains true equilibrium, can be set up on a laboratory bench top, and requires only a small quantity of charge material.

Circle No. 15 on Postcard

Pouring Spout and Tilter

The General Scientific Equipment Company is offering a new pouring spout and tilter designed to prevent accidents and to save materials, caused by spilling, splashing and carelessness in pouring liquids into smaller containers. A chain is provided to hold the bottle in position when tilted. The cradle is made of steel and all members are riveted or welded to insure a strong and durable unit. The safety air vent pouring spout fits any size bottle and assures even flow. This unit is made of acid-resistant rubber and plastic tubing.

Circle No. 16 on Postcard

Lubricant Fuel Catalyzer

A catalytic apparatus especially created for hydrocarbon treatment, Solatone, has been made available by A. B. Hydrocarbon Systems. The apparatus consists of a metallic vessel or shell which encloses a special catlytic cell. When the liquid to be treated is in contact with the cell, a catalytic action is set up immediately, creating a "dispersive phenomenon" effective in dispersing the hydrocarbon molecules, whether it be fuel or lubricant. This new aid in the lubrication of thermal engines eliminates carbon deposits, gums and sludges caused by the final transformation or destruction of the petroleum products in the combustion chamber.

Circle No. 17 on Postcard

Corrosion Preventive Usage

A booklet describing the use of Kontol as a corrosion preventive in refineries and gasoline plants has been published by the Tretolite Company which includes applications, methods of surveying corrosion rate, physical properties of Kontol and sample calculations for the determination of corrosion rate.

Circle No. 18 on Postcard

The only evidence of Lummus at this stage of the project is a team of 'dozers doing initial clearing. But soon it will be a completely-integrated petroleum refinery . . . or a modern chemical plant . . . or petroleum chemical units employing the newest and best processing concepts.

Meanwhile, the earth-movers are prophetic. They signal the application of Lummus' complete one-contract, one-responsibility engineering service from initial studies through acceptance run. And the trademark they wear means that *every* Lummus man who has a hand in the project has a strong and steady desire to make *this* the best job ever turned out by the company.

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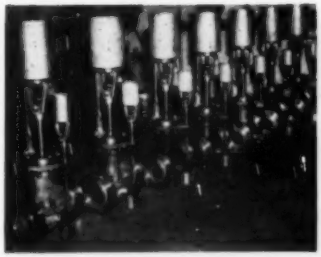
DESIGNING ENGINEERS AND CONSTRUCTORS FOR THE PETROLEUM AND CHEMICAL INDUSTRIES

Versatile Control Valves



Two new control valves, Models 1570 and 1780 capable of handling a wide variety of materials at extremes of pressure and temperature, have been announced by the Annin Company. The valves are capable of handling liquid nitrogen at a temperature of —325° F. and a pressure up to 3000 psi, red fuming nitric acid at room temperatures and superheated steam up to 1000° F. These single-seated valves feature an external self-balancing arrangement which provides a balanced valve effect in operation.

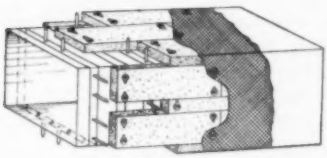
Circle No. 19 on Postcard

Liquid Level Gauges, Valves

A complete description of Jerguson Gage & Valve Company's gauges and valves for the observation of liquids and levels is contained in a recent bulletin issued by the company. Included are cutaway drawings, sizes, dimensions, weights, pressure groups available, and code numbers for ordering.

Circle No. 20 on Postcard

Metal Insulation Strapping



Finger Strap, a new metal strapping for applying all types of insulation to pipes, ducts, tanks and flat walls, has been developed by A. J. Gerrard & Company. The strapping is available in continuous coils in plain steel, galvanized, stainless 430, or monel. It is ¾-inch wide in thicknesses from .015 to .035. One-fourth-inch wide tapered fingers are spaced at intervals of 5 to 12 inches and serve to secure the insulation. It can be nailed or screwed to a wall or other flat surface. Once fastened, the steel fingers are lifted outward to a 90-degree angle and the insulation impaled on them. Full information is available on request.

Circle No. 21 on Postcard

Lightnin Mixer Catalog

A catalog describing turbine-type Lightnin Mixers for open and closed tanks and containing a factual discussion of fluid agitation has been released by the Mixing Equipment Company, Inc. showing how to anticipate process changes by installing a mixer with interchangeable speeds, it also describes how a standard design mixer can be adapted to give the versatility of a custom design unit. A complete listing of the new line of Lightnin Series "E" mixers, available in sizes from 1 to 500 hp, offering up to 16 standard AGMA speeds from one basic gear reducer drive is included.

Circle No. 22 on Postcard

Threaded Steel for Repairs

A threaded steel rod for industrial repair, installation and construction work has been put on the market by the Richardson Company. It is designed for jobs requiring long bolts or rods, or bolts of special shape. Known as "Redi-Bolt," it comes in straight 36-inch lengths, in six diameters and is made of cold drawn steel with a rust resistant coating. U-bolts, L-bolts or eye-bolts can be made by heating the rod with a blowtorch and bending to desired shape. No threading is necessary.

Circle No. 23 on Postcard

Deaerating Heaters Booklet

A new bulletin on tray-type deaerating heaters has been issued by Graver Water Conditioning Company, manufacturers of equipment for all water treating processes. The bulletin explains the principles of successful deaeration and the essential elements of a deaerating heater. The features of Graver Tray-Type and Spray-Tray-Type heaters are described in tabular form and illustrated by drawings with identifications of all parts. Included in the bulletin are flow diagrams and photographs of typical Graver Heater installations.

Circle No. 24 on Postcard

Flyweight Respirator Hood

The American Optical Company has announced its "flyweight" respirator hood, designed specifically for dust and paint spray protection, is now being made with a new replaceable plastic window. The hood is available with the company's R2000 seven interchangeable cartridge and disc filter respirator. Formerly, the window of the No. 75 respirator hood was sewed to the hood and could not be detached for replacement. Now, with the aid of seven snap fasteners, the window can be replaced. The hood has two drawstrings which tie under the arms, is reinforced with leather, and fits any head due to an elastic strap sewn to the back of the hood.

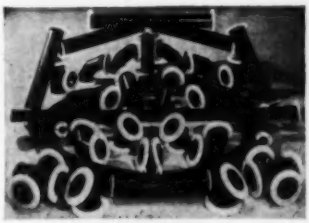
Circle No. 25 on Postcard

Centralized Instrumentation

Bulletin 85-20, recently issued by the Brown Instruments Division of Minneapolis-Honeywell, describes conventional and graphic type panelboards, as well as the measuring and control instruments utilized. Contents include sections on pneumatic and electric transmission, pneumatic receivers and controllers, panel engineering and centralized panelboards.

Circle No. 26 on Postcard

Semiflexible Plastic Piping



A durable, but semiflexible, plastic piping, highly resistant to a wide variety of solvents and unaffected by mineral acids, salts and alkalies at temperatures up to 150° F., has been made available by Munray Products, Inc. Company officials claim it is also unaffected by temperatures as low as —50° F. and retains all its properties through freezing and thawing. Made in sizes from ½-inch to 6 inches, it is furnished in stock lengths of 25 feet in four-inch or larger pipe, 150-foot coils for three-inch pipe, 250 foot coils for two-inch pipe and up to 400 feet in smaller sizes.

Circle No. 27 on Postcard

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Stainless Steel Nozzles

A new line of all-stainless steel fixed installation fog nozzles for industrial processing and fire protection has been announced by Bete Fog Nozzles, Inc. The new nozzles, known as the AA Series, are smaller in size and lighter in weight than previous models. The nozzles employ the patented spiral principle of atomization and incorporate improvements over earlier models. Bete AA Series are available in six models, three flow rates and with a full or hollow cone fog pattern. A ¼-inch male pipe thread connection is standard, with a ⅜-inch pipe thread available on special order.

Circle No. 28 on Postcard

Strip-Chart Potentiometers

An information bulletin concerning a number of new electronic instruments for recording and indicating such variables as temperature, pH, speed, voltage, power, current, smoke density, thickness, strain and a wide range of other variables which can be measured in terms of d-c current, d-c voltage, resistance or capacitance has been published by The Bristol Company. Describing the Bristol line of Dynamaster Electronic Potentiometers and Bridge Instruments for industrial plant, pilot plant, process, research and laboratory use, the bulletin is illustrated with photos of the basic electronic components of instruments and of the various models offered. Charts and wiring diagrams are included.

Circle No. 29 on Postcard

Rusting of Low Alloy Steel

The International Nickel Company, Inc., has announced a booklet entitled "A Theory of the Mechanism of Rusting of Low Alloy Steel in Atmosphere" based on results from exposure tests on 71 low alloy structural steels exposed in industrial and marine atmospheres. The tests lead to a new theory of the mechanism of rusting, discussed in the book, which satisfactorily accounts for the improved corrosion resistance secured by the addition of nickel to steel.

Circle No. 30 on Postcard

Porous Stainless Steel

The Micro Metallic Corporation has announced the availability of high tensile, smooth surface, porous stainless steel sheets with shear strengths in the range of 60,000 pounds per square inch. Surface smoothness is comparable to commercial rolled stainless steel sheet finishes. Flow capacities of this material range downward from 200 CFM of air per square foot of filter surface at 10 pounds per square inch of differential pressure, or from 20 GPM per square foot of water at 10 pounds per square inch differential. Pore diameters ranging from 20 microns down to zero can be obtained.

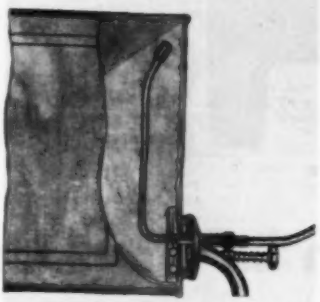
Circle No. 31 on Postcard

Pipeline Strainers Bulletin

The latest bulletin published by The V. D. Anderson Company describes the complete line of Anderson Self-Cleaning pipe line strainers made in sizes from ¼-inch to three inches. A discussion titled "Value of Sediment Control" points out the various pieces of pipe line equipment needing strainer protection. The bulletin also contains complete specifications and prices on the product.

Circle No. 32 on Postcard

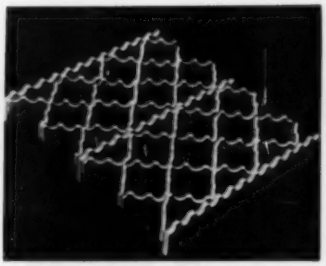
Non-Corrosive Fluids Spigot



A new type spigot for dispensing oils, solvents, glycerine, or any other non-corrosive fluids, from five-gallon cans has been announced by the Scientific Glass Apparatus Company, Inc. Known as the Klix Speedy Spigot, the unit employs a universal fitting so that it can be used on any size opening up to two inches regardless of the type closure. The fitting, a weighted toggle-type retaining bar, spans the bottom of the can opening. The design also utilizes a proper-seating lapped plunger and an automatic ball valve in the air tube. The spigots are made of cadmium-plated copper to resist corrosion.

Circle No. 33 on Postcard

Slip-Proof Stock Grating



A ⅛-inch stock grating which prevents walking hazards due to oil, grease or water has been developed by the Bustin Firm-Grip Grating Corp. The manufacturers claim recent laboratory tests prove the serrated edges are slip-proof after being submerged in chasis grease and tilted to a 15-degree angle. The product is manufactured for installations where excessive oil, grease, water or icy conditions make walking hazardous, and where drainage and sanitation are necessary.

Circle No. 34 on Postcard

Diesel Ignition Improver

Samples of a new ignition improver for diesel fuel are being made available by Ethyl Corporation for evaluation by the oil industry. The new fuel additive will make it possible for refiners to improve the cetane number of middle distillates, thereby increasing the potential output of desired grades of diesel fuel. As little as one-tenth of one percent, by volume, of the ignition improver is sufficient to bring many distillate heating oils within the cetane number range of commercial diesel fuels. Laboratory tests indicate that cetane numbers gained with Ethyl's ignition improver are the equivalent of natural cetane numbers and that this quality is retained in storage. Commercial production awaits the extensive tests now underway.

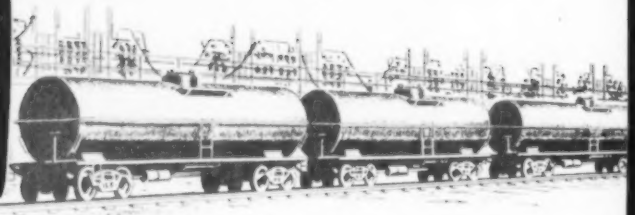
Circle No. 35 on Postcard

Gas and Liquid Analyzer

The MSA Infra-Red Gas and Liquid Analyzer, designed for rapid automatic analysis of fluid mixtures, precise control of either continuous or batch-type processes, and measurement of toxic contaminants in atmospheres, is described in a new bulletin being offered by Mine Safety Appliances Company. The Lira-type analyzer, capable of measuring concentrations as low as 2 ppm in many cases with less than two percent full scale drift per day is fully reviewed. Several examples of general applications are listed, along with a complete description, construction details and operating methods.

Circle No. 36 on Postcard

ORBIT VALVES®



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PLUS—Additional protection of an all forged steel body and bonnet. Forgings are of a known strength and density, being more homogeneous than castings, thus further eliminating the possibility of vapor leaks.

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Steel Vapor Condensers

The Doyle & Roth Manufacturing Company has announced its new line of Standard "Stainless Steel Vapor Condensers." These units are offered in two basic designs, Model VT for condensing vapors through the tube side, and Model VS for condensing vapors on the shell side. Literature is available upon request.

Circle No. 37 on Postcard

Laboratory Apparatus News

Recently off the press is Volume 21, Number 4, of The Laboratory, available on request to "those interested in the latest developments in laboratory apparatus and technique," through Fisher Scientific Company. News items, feature stories, laboratory hints and developments make up the contents of this pocket-size magazine.

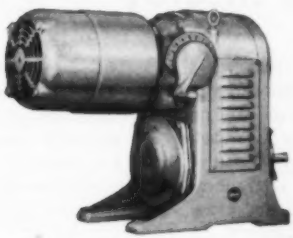
Circle No. 38 on Postcard

Centrifugal Pump Booklets

Two instruction booklets covering the installation, operation and repair of its single-stage, single-suction and multi-stage centrifugal pumps have been released by Allis-Chalmers Manufacturing Company. The booklets include a description of "Magic-Grip" couplings, universal joint couplings with "Magic-Grip" bushings, mechanical seals, etc. Section drawings are large for easy reference.

Circle No. 39 on Postcard

Explosion Proof Motor



To provide a motor which can operate in dangerous locations, U. S. Electrical Motors, Inc., has designed a combined explosion-proof-Varidrive motor which is self contained, all mounted in one frame, and occupying a single base. This design results in a saving of space and elimination of intermediate connections. Air movement is blasted over the enclosed motor element from the exterior by a spark proof fan housed within the end sector. This motor unit is mounted on the Varidrive assembly and by turning a control dial, change in speed is provided instantly.

Circle No. 40 on Postcard

Storm Door for Gas Masks

To meet the problem of frozen gas mask valves in sub-zero temperatures and to eliminate curling of valves due to rubber solvents, Acme Protection Equipment Company has developed a new type auxiliary valve designed for use with the company's gas masks. Known as the Acme "Protect-A-Valve," the new product provides a secondary valve that fits over the regular exhalation valve. It provides protection in temperatures ranging down to 50 degrees below zero. A bulletin containing complete information is available upon request.

Circle No. 41 on Postcard

Corrosion Resistant Valves

A service bulletin describing types, sizes, operation and features of Nordstrom corrosion resistant valves has been issued by Rockwell Manufacturing Company. Special reference is made to Nordstrom multiport, steam jacketed and power operated valves and their applications in the chemical and process industries. The bulletin contains typical analyses of several alloys, and tables are included listing approximately 175 different chemicals with their recommended alloy valves and lubricants. A special section is devoted to lubricants and lubricant equipment.

Circle No. 42 on Postcard

Building Materials Manual

A reference manual produced by The Philip Carey Manufacturing Company contains a complete listing of 800 building materials and industrial products obtained from asbestos, asphalt or magnesia. The manual shows Army, Navy, MIL, Federal, ASTM and other specifications, plus their corresponding product. The manufacturer indicates if the products meet, can meet, or do not meet required specifications. All information is cross-indexed to provide efficient reference.

Circle No. 43 on Postcard

Braided Asbestos Packing

Details on a Telefon impregnated braided asbestos packing which can be furnished in coil form or solid continuous ring form are included in a new catalog sheet published by Flexrock Company. The sheet includes recommended applications and chemicals against which the packing may be used.

Circle No. 44 on Postcard

Horizontal Emulsion Treater

Black, Sivalls & Bryson, Inc., has announced the publication of a bulletin on the new Horizontal Emulsion Treater written in non-technical language and illustrated with diagramatic drawings and charts. Capacities, specifications, and construction features of the unit are fully dealt with.

Circle No. 45 on Postcard

Heavy Duty Turbine Mixers

International Engineering, Incorporated's complete line of heavy duty turbine mixers, mixer drive heads and slow speed mixers for both open and closed tanks are fully described in the company's latest catalog. Schematic drawings, specifications and mixer data are included along with a section on International's Type "O" Mixing Tank.

Circle No. 46 on Postcard

Industrial Instrumentation

Brown Instruments Division, Minneapolis-Honeywell Regulator Company, has issued a book on "The Fundamentals of Instrumentation for the Industries," which covers the fundamentals of measurement, control and transmission of variables encountered in industry. Typical applications are also discussed.

Circle No. 47 on Postcard

Improved Electrode Holder

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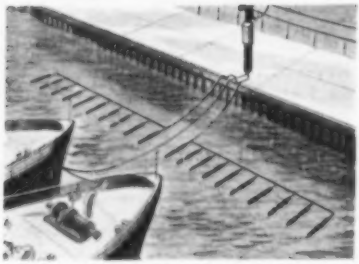

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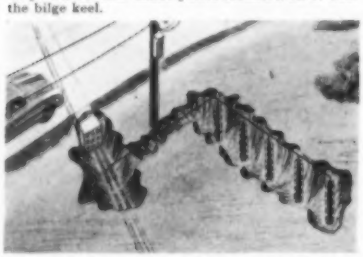

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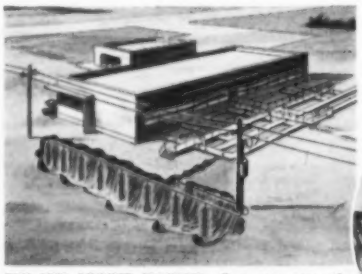

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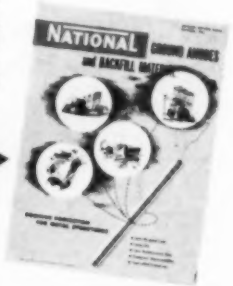

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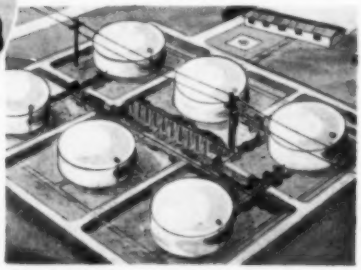

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SCIENCE and TECHNOLOGY Abstracts

Prepared by
DR. E. H. LESLIE and DR. H. B. COATS
The Leslie Laboratories
Traver Road, Ann Arbor, Mich.

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IT IS THE AMERICAN SYSTEM OF COMPETITIVE ENTERPRISE WHICH MAKES THIS RECORD-BREAKING ACHIEVEMENT POSSIBLE!

Fundamental Physical and Chemical Data

The Pressure-Volume-Temperature Relations of 3-Methylpentane, H. O. DAY WITH W. A. FELSING, *Jour. Am. Chem. Soc.*, **74** (1952) pp. 1951-1953.

The investigation reported is one in a program for the determination of the compressibilities of the isomeric hexanes. In the present investigation the compressibilities and vapor pressures of 3-methylpentane were studied, thus completing the p-v-T data for the five hexanes. The temperature range covered was 150° to 231.2° C. Equations representing the data are given, and a comparison is made with previously reported data in the literature. Compressibility data on the liquid in the range from 80° to 275° C. are presented in tabular form. The calculated values of the molar heats of vaporization are given also in tabular form.

Pressure-Volume-Temperature Relations in Liquids and Liquid Mixtures. I. The Compression of Hexane, Heptane, Octane, and of Their Binary and Ternary Mixtures Up to 5000 Atmospheres, H. E. EDULJEE, D. M. NEWITT AND K. E. WEALE, *J. Chem. Soc.* (1951) 3086-91.

The compressions of the liquid were determined at 0°, 25°, 40°, and 60° C. The isotherms are expressed in the form of the Tait equation. The energy-volume coefficients and the pressure coefficients are pure volume functions, and at all the temperatures and pressures studied the hydrocarbons mix without expansion or contraction in volume.

Viscosity of Neopentane, M. K. PHIBBS, *J. Chem. Phys.* **19** (1951) pp. 1420-1.

The viscosity of neopentane was measured between —15° and 30° C. The results obtained were consistent with published data covering the temperature range of 30° to 150° C. The viscosity data for neopentane were compared with viscosity data for the other pentanes. The comparison shows the importance of molecular shape in connection with viscosity behavior. The significance of molecular shape in the interpretation of viscosity curves of binary solutions is noted. The work suggests that further work on liquids composed of spherical molecules might be worth while.

The Viscosity of the System Methanol-Toluene, NIELS MADSEN, *Science* **114** (1951) pp. 500-1.

The system methanol-toluene shows a minimum and maximum viscosity at 15 and 76 mole percent methanol, respectively. When methanol is added, there is a contraction of the system at methanol concentrations greater than 20 mole percent with a maximum —ΔV at 75 mole percent. ΔV was not determined below the 20 mole percent methanol. The lowering of viscosity must be caused by a reduction in length of the association polymers of methanol as well as the volume change.

Thermal Conductivity of Granular Solids Through Which Gases Are Flowing, DONALD F. MOLINO AND JOEL O. HOUSEN, *Chem. Eng. Progress* **48** (1952) pp. 147-9.

The work reported is an extension of that of Hougen and Piret in which a generalized equation for the effective thermal conductivity of certain granular solids through which gases are flowing was presented. In the previous investigation the gas was cooled during downward flow through the cylindrical bed of granular material. The object of the present work was to determine whether any difference might arise if the gas were heated instead of being cooled. Air was passed under temperature and flow control downwardly through a bed of celite pellets supported in a relatively short cylindrical container. The container was surrounded by an annular space through which cooling or heating media could be introduced. No significant dependence upon the ratio of bed to pellet dimension was observed. It is concluded that bed dimensions have no influence on the average conductivity values unless the bed to pellet diameter is less than approximately six.

Spontaneous Ignition of Organic Compounds, CHARLES E. FRANK AND ANGUS U. BLACKHAM, *Ind. Eng. Chem.* **44** (1952) pp. 862-7.

The literature of spontaneous ignition of organic compounds is briefly reviewed and reference is made to bibliographies on the subject. The disagreement of data in the literature has prevented any but the most general correlation of spontaneous ignition temperature with structure. The objective of the present work was the development of information that would permit the formulation of lubricants of reduced flammability. Other specific objectives were to determine the effects of structure on spontaneous ignition and to observe the influence of metal catalysts and various additives on spontaneous ignition temperature. Spontaneous ignition temperatures of a series of straight chain paraffins, alpha olefins, primary alcohols, and symmetrical ethers, containing 10 to 20 carbon atoms are summarized graphically. Alcohols have the highest spontaneous ignition temperatures, the olefins next lower, paraffins next lower, and the ethers lowest. For those compounds having spontaneous ignition below 290° C., metal surface has substantially no effect, but for compounds of high spontaneous ignition temperature the catalytic effect of the metal surface becomes pronounced. Some 60 compounds were tested as additives at concentrations of 5 mole percent for their effect on the spontaneous ignition temperature of n-dodecane. Powerful anti-knock compounds, that is those capable of inhibiting chain reactions in the cool flame region, have a major effect on spontaneous ignition temperatures. Tetraethyllead is an outstanding additive for raising the spontaneous ignition temperature. A bibliography of 22 references is included.

Methods for Treating Data from Multiplate Equilibrium Stills, T. M. REED III AND H. S. MYERS, *Ind. Eng. Chem.* **44** (1952) pp. 914-16.

Multiplate vapor-liquid equilibrium stills are useful in obtaining data on systems the relative volatility of the components of which are close together and for which, therefore, accurate differences in composition are hard to obtain by the use of single theoretical plate stills. However, the multiplate equilibrium still has the disadvantage that samples are taken several theoretical

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plates apart. Construction of the usual X-Y diagram from such data is not immediately obvious. The authors discuss the relative sampling point locations that must be used in order that the equilibrium curve may be obtained. Two graphical procedures are presented by the use of which multiplate equilibrium data can be translated into the equilibrium diagram. One procedure requires that samples be taken at three points, each separated from the other by one or more equilibrium plates. The second method requires two samples and at least one known point on the conventional equilibrium curve. The methods allow an accurate value of the relative volatility to be assigned to any intermediate composition existing between the particular sample point compositions.

Evaporation From Drops. Part I, W. E. Ranz and W. R. Marshall, Jr., *Chem. Eng. Progress* **48** (1952) pp. 141-6.

Fundamental data on the factors affecting the rate of heat and mass transfer from a droplet are important in spray drying, spray cooling, humidification, spray absorption, spray extraction, combustion, crystallization, dissolution, transfer in fluidized beds, and similar operations. The authors report a fundamental study of the evaporation from drops. The study included an investigation of the rate of heat transfer to the drop surface, rate of evaporation and mass transfer from the drop surface, temperature and concentration at the drop surface during evaporation, and the effect on evaporation rate of original drop temperature, heats of solution and crystallization, and the way in which solid surfaces form. Application of the results was made specifically to spray drying. The study was restricted to Reynolds numbers in the range of 0 to 200, and drop diameters from 0.06 to 0.11 cm., and air temperatures up to 220° C. The results on pure liquid drops confirm the analogy between heat and mass transfer at low Reynolds numbers, and verified the simple expression for the Nusselt number at zero Reynolds number. The results showed that when a solid was in solution the drop evaporated initially as though it were saturated throughout, even though its average concentration was less than saturation. For drops containing insoluble materials, the initial evaporation rate was found to correspond to that for pure water.

Chemical Composition and Reactions

The Kinetics of the Thermal Decomposition of Olefins. Part II. M. J. Molera and F. J. Stubbs, *J. Chem. Soc.* **1952**, pp. 381-91.

A study was made of the thermal decomposition of the olefins pentene-1, hexene-1, 2-methylbutene-1, 3-methylbutene-1, butene-1, heptene-1, butene-2, and isobutene. The system used was a static system. The observed increase in pressure was shown to be a measure of olefin decomposition, at least for the first part of the decomposition. In all cases the reactions were found to be of the first order down to quite low pressure, where the characteristic transition towards second-order reaction occurs. The activation energies were determined and, within the experimental error, do not vary with the initial pressure. The decomposition of isobutene was studied in more detail as regards the mechanism of the reaction, and a tentative mechanism is proposed. Because the decomposition or the reactions of ethylene differ from those of the higher olefins in many respects a separate study of this substance was made. At lower temperatures, such as 623° C., ethylene was consumed in accordance with a second-order equation, but gaseous products, including paraffins and hydrogen, are found in the decomposition products; 30 percent of the carbon atoms were found in the gas phase. The activation energy for ethylene varies with pressure, giving an extrapolated value of 75 kcal./mol. at zero pressure. Both polymers and gaseous products were produced at all temperatures studied.

The Reaction of Nitrogen Atoms with Methane and Ethane, H. Blades and C. A. Winkler, *Can. J. Chem.* **29** (1951) pp. 1022-7.

The only reaction product produced in significant amount from nitrogen and the hydrocarbons was HCN. The apparatus used in the work was previously described by the authors. At high temperatures and with excess of ethane, the nitrogen atom consumption was complete, and comparison of the HCN production and the gage reading showed that atomic nitrogen was the only active species present. The reaction between nitrogen atoms and methane has an activation energy of 11 kcal. and a steric factor of 5×10^{-3}. The nitrogen atom-ethane reaction is of 2nd order and has an activation energy of 7 ± 1 kcal. and a steric factor between 10^{-1} and 10^{-2}. A mechanism for the reaction is suggested.

Catalytic Hydrogenation of the Oxides of Carbon to Higher Hydrocarbons, Robert N. R. Mulford and W. Walker Russell, *Jour. Am. Chem. Soc.* **74** (1952) pp. 1969-74.

The problem of producing higher hydrocarbons from the oxides of carbon, such as carbon dioxide, may be considered one of controlled or partial reduction followed by polymerization. The reactants studied were carbon dioxide and hydrogen. The catalysts used were ceria-promoted copper-containing cobalt catalysts. The effects of carbonates, chlorides, sulphates, thiosulphate and sulphide added singly as potassium or sodium salts were studied. All of the cobalt catalysts produced oil when the initial carbon dioxide-hydrogen mixture was first passed over supported iron, water gas catalyst. With no water gas catalyst present only the cobalt catalysts containing potassium carbonate or sulfate produced oil. In general the effects of certain of the catalyst additives were to alter the distribution between liquid and gaseous synthesis products, to increase oil yields and to shift the temperature range for maximum oil yields. The effects of the additives are apparently the selective activation or beneficial poisoning of the cobalt catalysts.

The Fluorination of Hydrocarbons with Cobalt Trifluoride, A. K. Barbour, G. B. Barlow and J. C. Tatlow, *Jour. Applied Chem.*, **2** (1952) pp. 127-33.

The authors studied the vapor phase fluorination of hydrocarbons using cobalt trifluoride. The apparatus for generating fluorine is described. The apparatus for the fluorination comprised a nickel tube three feet six inches long and 3¾ inches internal diameter, and was agitated with an agitator having paddles fixed to a shaft and turned 4 r.p.m. The reaction ran smoothly, and good yields of fluorohydrocarbons were obtained. Cobalt trifluoride was regenerated by leading fluorine through the reactor at 250-300° C. The optimum reaction temperature for the fluorination is usually in the range 300-350° C. The hydrocarbons fluorinated were diphenyl and a series of diphenyl derivatives from diphenyl methane to diphenyl hexane. A bibliography of 20 references is included.

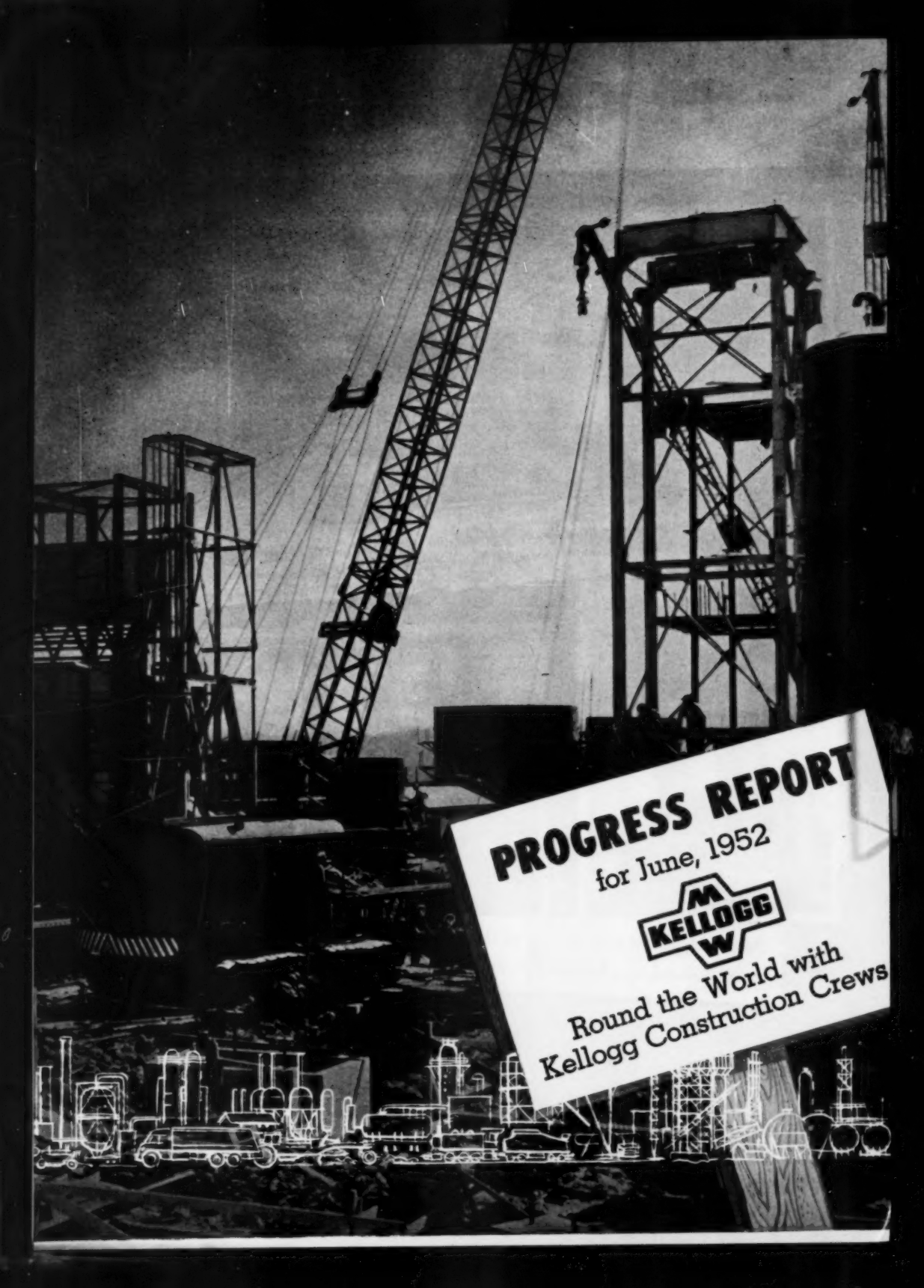
Manufacture: Processes and Plant

What Goes on Inside Bubble-Cap Towers? Frederick A. Zenz, *Chem. Eng.* **59** (952) pp. 169-173.

In the past tower design has been based on vapor velocity through the cross-section of the tower and fixing the velocity to give some chosen entrainment from tray to tray. There is at present a shift towards tower design that starts the cap and works out to the vessel diameter. It appears advantageous, but not essential, to set specifications that will insure operating with slots blown open not less than 0.3 inches and not greater than 1.25 inches. Data are given on cap performance using the air-water system. An equation is given for cap vapor capacity. This equation permits calculation of the required number of caps per tray for a given vapor load, as a function of the degree to which the slots are blown open. A chart, calculated from the equation, is presented. It is general design practice to space the caps so that the annular area around the outside of each cap, in which the vapor travels upward through the liquid, is approximately twice the slot area or else that the caps are not less than 1½ inches apart. Reference is made to a recent paper by Kirschbaum in which it is concluded that the optimum cap diameter should be about three inches. However, about 20 percent more caps should be allowed than are theoretically calculated to allow for area losses at the tray periphery and at the weirs. A chart is given for the rapid graphical solution of tower diameter with a specified liquid load and a certain required cap area. Downcomer velocities as low as two inches per second and as high as 22 inches per second have been found in practice. As a general rule it is customary to assume four inches per second for design purposes. The minimum allowable tray spacing is given in a table showing tray spacing for various slot submergences. A typical tower calculation is presented. Six references are included.

Wetted-Wall Tube-Plate Column. A Gas-Liquid Contractor, Joseph J. Martin, *Ind. Eng. Chem.* **44** (1952) pp. 920-4.

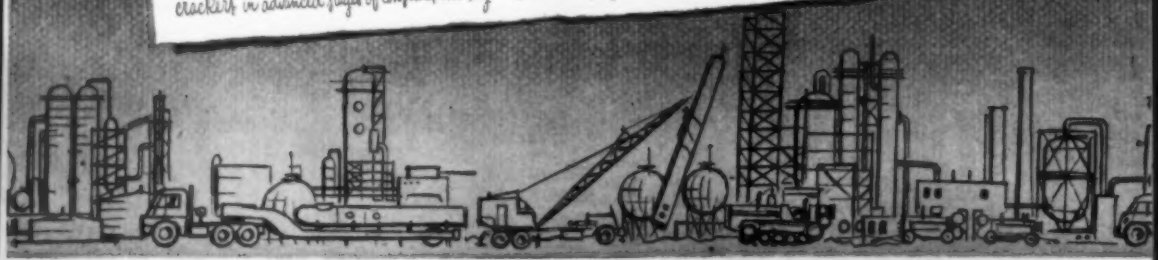
The author describes a plate column in which each plate comprises short, vertically set tube through which the vapor travels upwardly and the liquid downwardly on the tube wall surface. The column was tested at total reflux using the system trichloroethylene and tetrachloroethylene. Under the test conditions the column showed the possibility of using materially higher vapor velocities at a given pressure drop than are


PROGRESS REPORT
for June, 1952
M
KELLOGG
W
Round the World with
Kellogg Construction Crews

PROGRESS REPORT for June

On the Gulf Coast, foundations for the world's first Fluid Hydroformer are virtually complete. Pedestal in right foreground will support new-type, continuous, reaction and regeneration vessels. The compressor house is in the background.

In the British Isles, four major projects: Left - one Fluid cracker practically ready to go. Center - one of the two other crackers in advanced stages of construction. Right - shows the progress on fourth project: England's first propane deasphalter.



ROUND THE WORLD WITH KELLOGG CONSTRUCTION CREWS

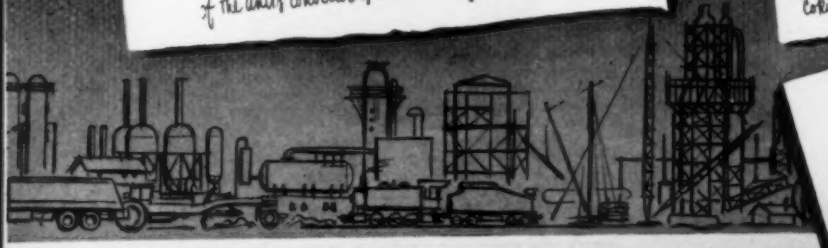
1952...

(PHOTOS SHOW ACTUAL FIELD CONDITIONS AS OF MAY 1, 1952)

In Ontario, at press time, this Orthoflow was going on stream. Canada's second, it is one of seven Kellogg single-vessel units, built or in work, for domestic and foreign refiners. This cracker and the other processing equipment (including cat poly) operate off one control room, at the far right.

On the Canadian plains, improved weather conditions speed the completion of an important modernization program including a Fluid cracker. This 90-ton tower between the gas poles is being moved 300 ft. into the new coking and thermal cracking area.

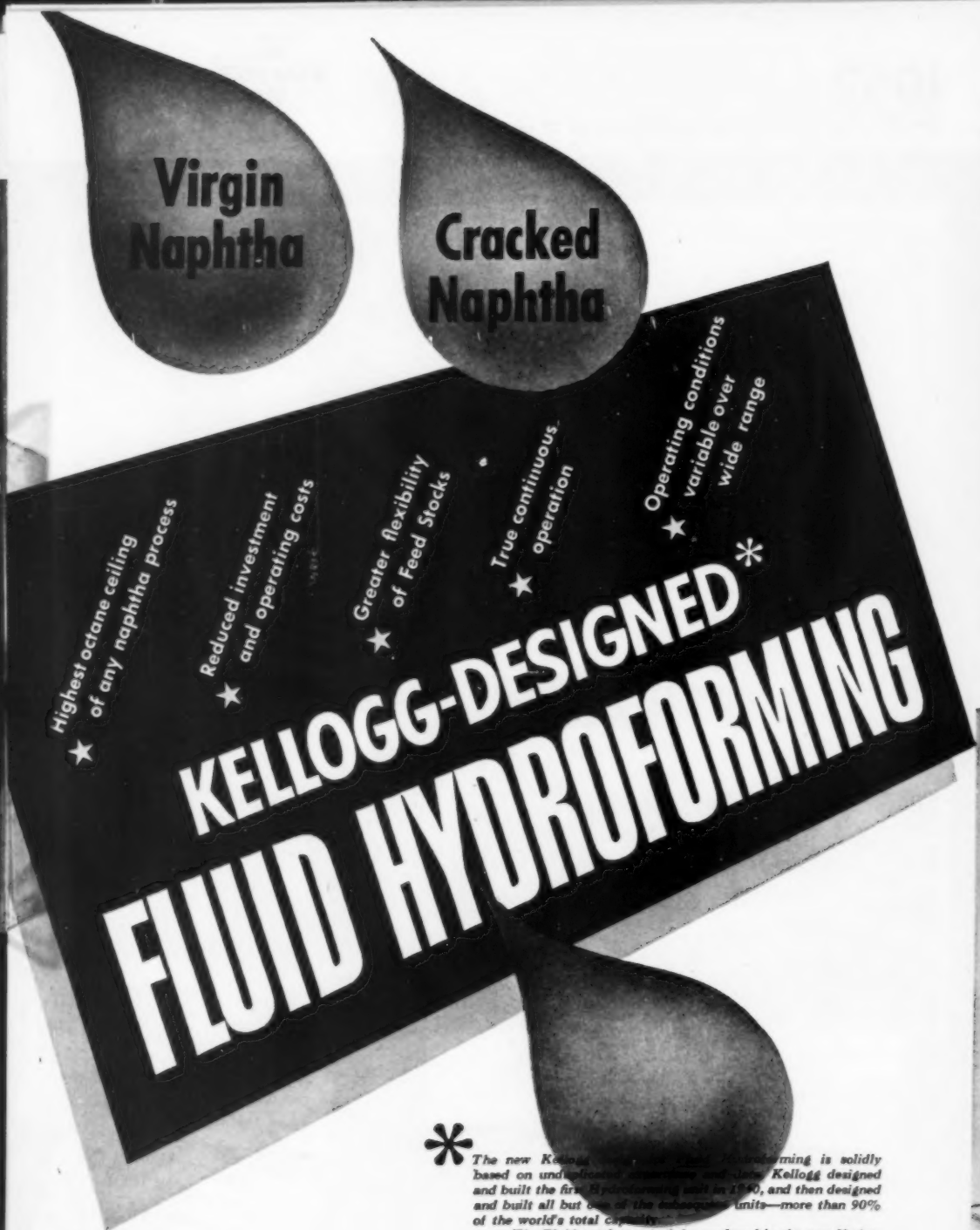
In the Southwest, foundation work for another Orthoflow cracker is just starting. Future location of the unit's converter is indicated by circle.



PROGRESS REPORT CONTINUED ON THIRD FOLLOWING PAGE... IMPORTANT! See next page for message about FLUID HYDROFORMING

M. W KELLOGG

ROUND THE WORLD WITH KELLOGG CONSTRUCTION CREWS



* *The new Kellogg [illegible] Hydroforming is solidly based on unduplicated experience and skill. Kellogg designed and built the first Hydroforming unit in 1940, and then designed and built all but one of the subsequent units—more than 90% of the world's total capacity.*

The Fluid catalyst principle employed in the new Hydroforming process was rapidly brought into commercial use by Kellogg, as evidenced by the fact that more than 70% of the world's Fluid catalytic cracking capacity is Kellogg-engineered. Naturally, Kellogg has been in the forefront of the development of Fluid Hydroforming, has obtained much data from the company's pilot plants over a period of years and has access to all important data pertaining to the subject.

Greater Flexibility of Feed Stocks!

Fluid Hydroforming, the *modern* upgrading process, permits a wider range of feeds than other naphtha processes . . . from hexane (for benzene production) to kerosene. It is effective on virgin heavy naphthas, and especially so on high-sulphur cracked naphthas and on a mixed virgin-and-cracked feed.

Reduced Pre-Cracking

The *Fluid* catalyst, a finely-divided powder moving continuously through the system supported on oil vapors and air, provides improved catalyst-naphtha contact and hence improved reaction. And since operation is continuous, the system gives steady, uninterrupted production on any given feed.

Specifically, a 55 octane naphtha can be reformed into automotive gasoline stock with a clear octane rating of 95 CFR-R, which means a final aviation gasoline product with rich-mixture aviation octane ratings above 175, with the addition of 4.6 cc of tetraethyl lead.

Fluid Hydroforming produces higher octanes than any other process of its kind . . . at low operating costs . . . and, compared with fixed-bed Hydroforming, at considerably lower initial investment.

A Kellogg bulletin, "FLUID HYDROFORMING", gives detailed data on the comparative performance, yields and octane ceilings of the process. It will be mailed on request.

THE M. W. KELLOGG COMPANY

(A Subsidiary of Pullman Incorporated)

for fifty one years an integral part of refining progress!

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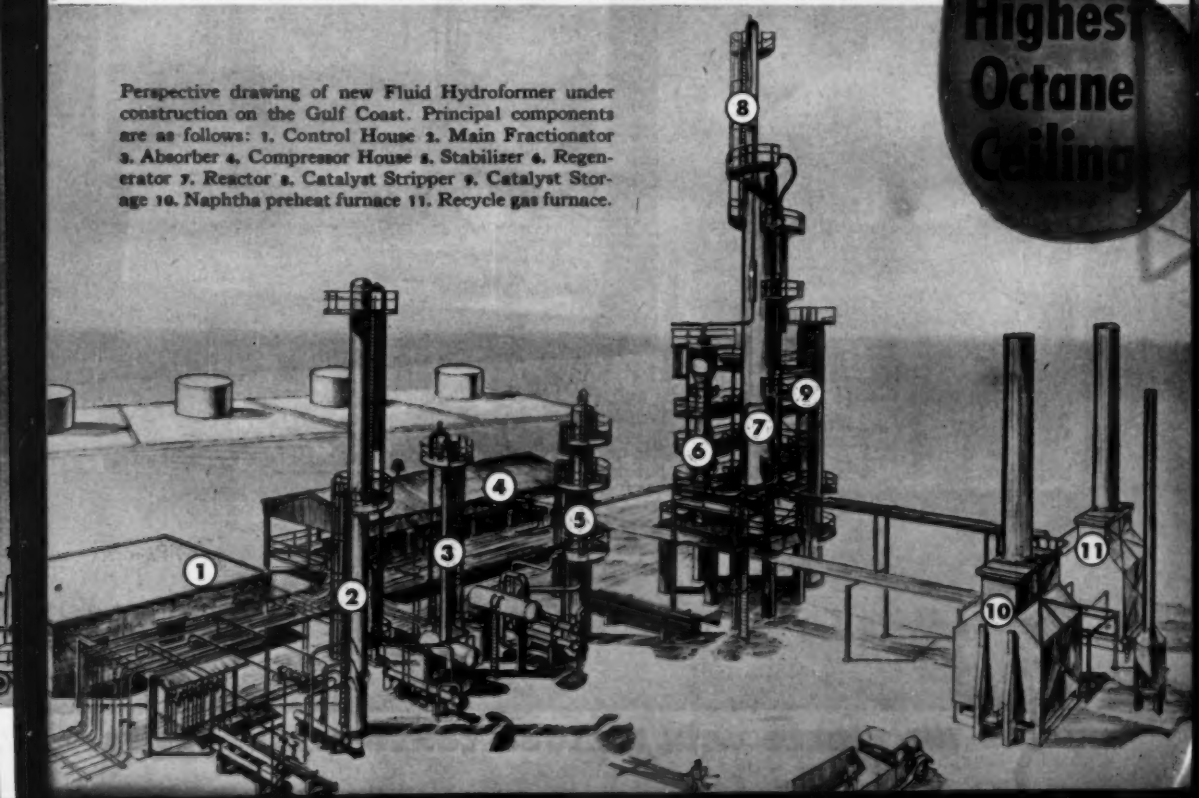
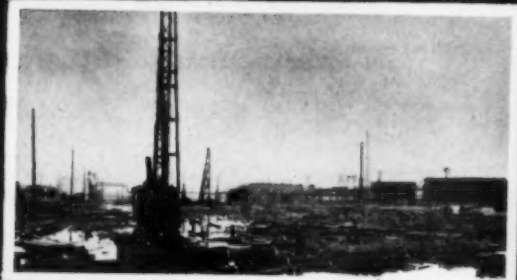
Highest Octane Ceiling



Perspective drawing of new Fluid Hydroformer under construction on the Gulf Coast. Principal components are as follows: 1. Control House 2. Main Fractionator 3. Absorber 4. Compressor House 5. Stabilizer 6. Regenerator 7. Reactor 8. Catalyst Stripper 9. Catalyst Storage 10. Naphtha preheat furnace 11. Recycle gas furnace.

PROGRESS REPORT for June



On the East Coast, piling is just about completed for another mammoth Kellogg cracker. With a reactor throughput of 63,000 BPD, it will be slightly larger than one Kellogg completed last year for the same refiner.

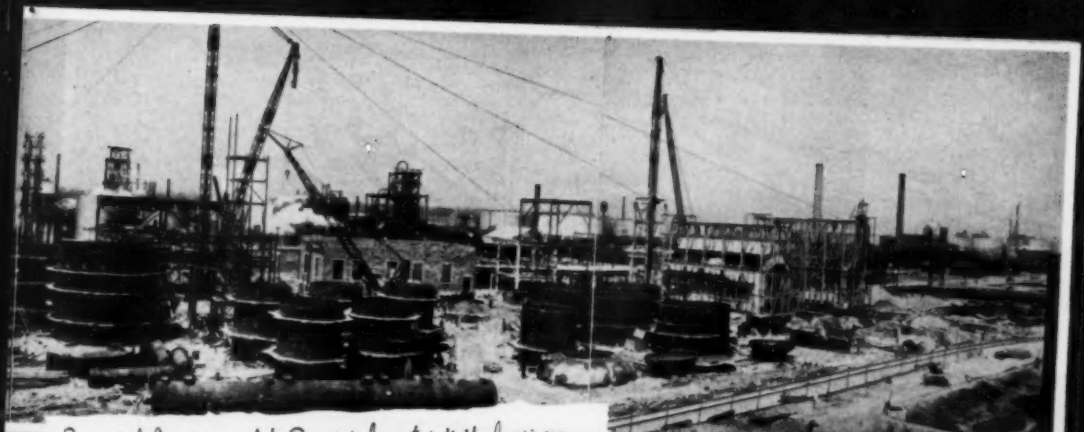
In Southern France, a refinery-wide modernization program has been underway for over a year. Currently, this many-trayed tower (for the close fractionation of propylene from a C-3 cut) is being installed.

ROUND THE WORLD WITH KELLOGG CONSTRUCTION CREWS

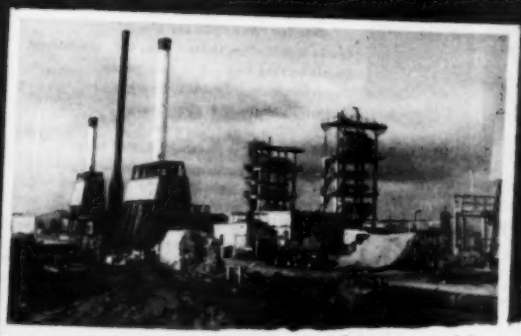
1952 . . . continued . . .

(PHOTOS SHOW ACTUAL FIELD CONDITIONS AS OF MAY 1, 1952)

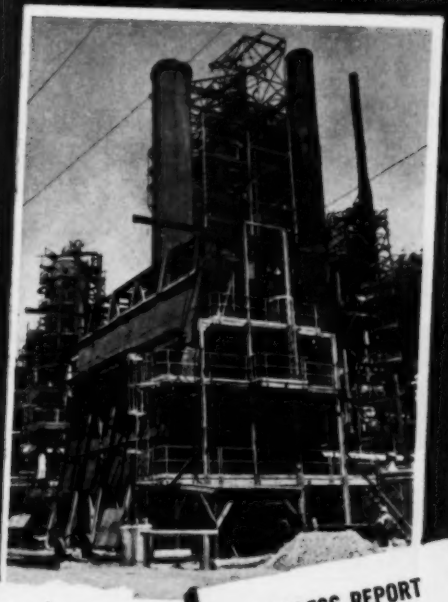
KELLOGG



In central Canada, two of the Dominion's largest individual refinery projects are well under way. This sweeping panorama of the entire construction area shows the sites for Canada's largest Fluid catalytic cracker, and its largest atmospheric and vacuum distillation unit



In Argentina, it's a complete 28,300-BPD refinery. Including Fluid Cracking, Delayed Coking and Alkylation, the job is moving steadily along aided by special schools set up to train local craft workers.



Down in Texas, two of the country's earliest Fluid crackers are revamped. The construction of this Kellogg-designed A-frame furnace was part of the extensive project.

PROGRESS REPORT CONCLUDED ON NEXT PAGE

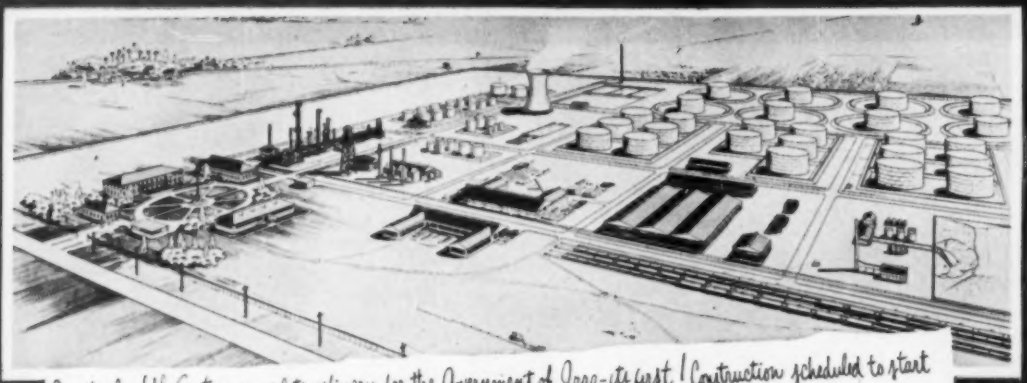
M. W. KELLOGG

ROUND THE WORLD WITH KELLOGG CONSTRUCTION CREWS

(continued)

PROGRESS REPORT for June 1952

(PHOTOS SHOW ACTUAL FIELD CONDITIONS AS OF MAY 1, 1952)



In the Middle East, a complete refinery for the Government of Iraq—its first! Construction scheduled to start later this year under Kellogg supervision

Out in Ohio, the site is cleared for another Orthoflow unit. Job includes considerable other new equipment as well as revamp work on existing units.

OTHER MAJOR CONSTRUCTION PROJECTS SCHEDULED

Alkylation Plant—*U.S. East Coast*
Ammonia Plant—*U.S. West Coast*
Cat Poly Units—*two, England and Italy*
Complete Thermal Refineries—
One for Chile; two for Brazil
Crude Distillation Units—*two, U.S. Southwest*
Deasphalting Unit—*U.S. Southwest*
Decarbonizing Unit—*U.S. Southwest*
Desalting Unit—*U.S. East Coast*
Fat Splitting Unit—*Norway*
Iso Octyl Alcohol Plant—*U.S. Mid West*
Olefin and Petrochemicals Plant—*Italy*
Orthoflow Crackers—*two,*
U.S. East Coast and Germany
Phenol Treating Unit—*U.S. Southwest*
Phthalic Anhydride Plant—*England*
Solexol Decolorizing and Fractionating Unit—*Norway*
Synthol Plant (Gasoline from Coal)—*South Africa*
Thermal Reforming Unit—*Italy*

In eastern Canada, construction of the world's first phenol-from-cumene plant is being pushed rapidly. At press time foundation piling had just been completed and erection was under way.

SEE NOVEMBER ISSUE THIS PUBLICATION FOR NEXT PROGRESS REPORT

M. W. KELLOGG

ROUND THE WORLD WITH KELLOGG CONSTRUCTION CREWS

possible with conventional bubble-cap columns. The author indicates, however, that further study is necessary before broad conclusions can be drawn. Such variables as tube diameter and liquid viscosity require further study. Data on vapor velocities, pressure drops and H. T.U. are presented in some detail in tabular and graphical form. Photographs of the column operating at low velocity and at high velocity are given.

Film Resistances in Rectification. II, J. ANDERSON STORROW, *Jour. Applied Chem.*, **2** (1952) pp. 120-7.

The author and associates have been making a study of the film resistances in rectification. A previous paper by Chari & Storrow was concerned with the system methanol-water. It was pointed out that the two major gaps in the physical data for a rectification system are the absence of information on the viscosity of mixed vapors at the condensation temperature and the diffusion coefficient of liquid mixtures at the boiling point. These two gaps have now been filled for the ethanol-water system. Using the new information, the data from the rectification of ethanol-water mixtures in a wetted wall column were analyzed using values for the diffusion coefficient of ethanol in the liquid phase. Data from differential measurements of the concentration distribution have not been correlated satisfactorily, but the liquid film resistance appears to depend on a function of the Hatta group, which confirms the conclusions of Chari and Storrow for the system methanol-water. A bibliography of 17 references is included.

Propane Deasphalted Gas Oil as Catalytic Cracking Feed Stock. Cracking over a Mixture of Natural and Synthetic Catalysts, E. CLARENCE ODEN AND THOMAS S. GRANBERRY, *Ind. Eng. Chem.* **44** (1952) pp. 896-902.

The authors present data obtained from cracking propane deasphalted gas oil and describe a method by which pilot plant correlations on individual feed stocks can be used to predict the yields obtainable commercially from cracking a mixture of the feed stocks. In general it is desirable to be able to predict the effect of changes in the operation of a commercial unit without the necessity of experimenting on the large unit. The correlations and procedure presented in the article have been checked against the data obtained from several process test runs on a commercial unit cracking a mixture of propane deasphalted gas oil and virgin light gas oil. Although the conditions and feed stock composition varied over a wide range, it was found possible to predict the effects of the changes on the yield structure with accuracy. The correlations can be used to predict the effect of operating changes on the commercial unit and thus to determine the optimum point at which the unit should be operated. The authors believe that the method of correlation presented can be applied extensively in catalytic cracking investigations. The data are presented in considerable detail in tabular and graphical form, and a bibliography of five references is included.

The Effect of Orientation and Shape on the Settling Velocity of Non-isometric Particles in a Viscous Medium, JOHN F. HEISS AND JAMES COULL, *Chem. Eng. Progress* **48** (1952) pp. 133-40.

The effect of orientation and shape on the settling rates of individual cylinders, rectangular parallelepipeds, and spheroids in the viscous region can be predicted from the general correlation presented graphically. It is believed that the correlation will be valuable when dealing with a wide variety of particle shapes. It should be useful in the design and operation of classification equipment, if correction factors are applied for flocculation effects when hindered settling occurs with suspensions. The free-settling velocity of a particle is determined principally by the position of orientation, the sphericity, and the h/d ratio of the particle. As the particle deviates from a shape of isometric proportions, the effect of its orientation increases. The coefficient of resistance to settling is found to vary in a manner similar to that of a sphere and can be calculated readily by the use of a particle settling factor K. A bibliography of 28 references is included.

Generalized Graphical Method for the Design of Fixed Bed Catalytic Reactors, THOMAS BARON, *Chem. Eng. Progress*, **48** (1952) pp. 118-124.

A graphical method is presented for the design of fixed bed catalytic reactors. The procedure is based on the lateral heat and mass transfer occurring in the catalyst bed, and is useful for all heat-transfer situations provided some simple symmetry, such as cylindrical symmetry, can be assumed. Equations are derived from statistical considerations for the effective lateral diffusivity of heat and mass. The equations are consistent with the experimental data reported, as well as with data presented by Bernard and Wilhelm, and Singer and Wilhelm. The theory, and also the data, indicates that the effective diffusivity for mass transfer is numerically equal to the effective diffusivity for heat transfer, provided the thermal conductivity of the catalyst pellets is low. It is also shown that the reactants and products are always present in stoichiometric quantity when the total number of mols passing through the reactor is essentially constant. This fact, combined with the identity of the effective diffusivities for heat and mass permits a simple graphical design that gives the distribution of temperature and also the fractional conversion. The design is based on rate data obtainable from differential reactors and gives the reaction rate in terms of the temperature and fractional conversion of the limiting reactant.

Hydrogen Fluoride Extraction of High-Sulfur Virgin Petroleum Stocks, A. P. LIEN AND B. L. EVERING, *Ind. Eng. Chem.* **44** (1952) pp. 874-9.

A new development in the field of desulphurization through extraction with hydrogen fluoride offers interesting possibilities. The paper describes the results of treating a wide variety of stocks with hydrogen fluoride, considers the effects of a number of variables, and interprets the results obtained on refinery stocks in the light of the previously discussed chemistry of hydrogen fluoride extraction. The reaction of desulfurization is presumed to be the formation of sulfur —hydrogen fluoride complexes that are essentially insoluble in the hydrocarbon phase but completely miscible with the excess liquid hydrogen fluoride. The reaction is fast, so that short times of contact are sufficient to establish equilibrium. Clean-cut separations into extract and raffinate phases are rapid. Increasing the amount of extracting acid increases desulfurization. The higher the boiling point of the stock, the harder it is to desulfurize it. Temperature has little effect up to 65° C., but above that temperature desulfurization decreases sharply. Dilution of hydrogen fluoride with water results in markedly decreased desulfurization. Boron trifluoride activates the acid to produce a stronger acid and thereby makes possible the removal of difficultly extractable sulfur compounds. The treatment with hydrogen fluoride improves the lead response with gasoline and will produce sweet kerosene. A bibliography of 16 references is included.

Science and Technology

Products: Properties, Utilization and Analysis

Oil Black, WILL H. SHEARON, JR., R. A. REINKE, AND T. A. RUBLE, *Ind. Eng. Chem.* **44** (1952) pp. 685-94.

The article is a collaborative report by the staff of Industrial and Engineering Chemistry and representatives of two carbon black producers. Eight hundred forty thousand short tons of carbon black were produced in 1951. Reference is made to extensive bibliographies covering the industry. There are many types of industrial carbon blacks, but those in greatest production are channel, thermal, and furnace blacks, which account for 97 percent of the world's production. Most of the black goes into rubber, but it is also applied as a pigment in printing inks, lacquers, and paints. Typical carbon black plants are described in some detail, together with the processing of the black itself, packaging and storage, and laboratory control. The future of the industry is briefly considered. A bibliography of 30 references is included.

Determination of Total Per Cent Aromatics in Heavy Petroleum Distillates. Modified Method Using Silica Gel Adsorption, A. T. WATSON, *Analytical Chemistry*, **24** (1952) pp. 507-9.

A method for determining the total aromatic content of heavy petroleum distillates was developed. This is relatively rapid and suitable for use in routine work. The procedure is similar to that described by Lipkin, but certain modifications make it more applicable to routine determinations and enabled one individual to complete several determinations in a day. The method utilizes the strong affinity of silica gel for aromatics. It is considered accurate to within ± 1.0 percent. The necessity for refractive index measurements has been eliminated, and the sample size has been reduced from 100 to 5 ml. The method is particularly useful in studying the effects of process variables in such operations as solvent extraction of gas oils and lubricating oil.

Determination of Cyanides in Refinery Waste Water, MAXEY BROOKE, *Analytical Chem.* **24** (1952) pp. 583-4.

The accurate determination of traces of cyanides in waste water has long been a problem. The particular problem under study concerned the formation of ammonium cyanide during the catalytic cracking of nitrogen-containing gas oils.

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Science and Technology

Cyanides are washed out of the gasoline and find their way into the refinery waste water stream. The quantity of cyanides is small, but state regulations prohibit the introduction of even this minute quantity into the streams used for disposal of refinery waste. A colorimetric method for the determination of cyanides was developed that does not require preliminary distillation and is sensitive in the range 0.5 to 3.0 p.p.m. of cyanide. Soluble cyanides other than alkaline cyanides offer no problem, as they can be converted to the alkali form by an ion exchange method.

R. H. Boundy Will Head Dow Chemical's Research Program

Dr. R. H. Boundy, manager of The Dow Chemical Company's plastics department since 1945, has been named to head the company's research activities. C. B. Branch, present manager of the company's technical service and development department will replace Boundy as manager of the plastics department. Boundy came to Dow as a chemical engineer in 1926 and has been closely associated with many of the company's developments in the fields of hydrocarbons and plastics. He served as assistant director of physical research from 1930 to 1941 when he was appointed assistant to the president. In 1945 he was named manager of the plastics department, and in 1950 was elected to the board of directors.

Branch, who becomes manager of Dow's plastics department, joined the company in 1937 and has been manager of the technical service and development department for the past two-and-a-half years. John Van Horn will replace Branch as manager of technical service and development.

Chemicals Wanted

The National Registry of Rare Chemicals, Armour Research Foundation, 33rd, Federal and Dearborn Streets, Chicago 16, has received urgent requests for the chemicals listed below. If anyone has one or more, even if only one gram quantities, please inform the Registry.

Tetralin hydroperoxide
3,6-Di-tert.-butylcatechol
Pentamethylene bromohydrin
5-Nitro-2-aminotoluene
para-Fluorophenol
N,N-Diethylpropane-1,3-diamine
Decanesulfonic acid
3-Cyanopyrene
1,4-Butanediol
Azopropane
9-Acetylphenanthrene
3,4-Xylidine
2,3,4-Trihydroxybenzene-1-carboxylic acid
4-Mercapto-2-phenylbenzothiazole
Methylcyclopropane
Butadiyne-1,3
Tetramethylenediisocyanate
Ethyl vinyl ketone
Cyclobutanol
Tetrasilane

FACT

Alcoa Aluminum Heat Exchanger Tubes require far less cleaning than Admiralty tubes in furfural service. Aluminum does not catalytically polymerize furfural. Furfural does not corrode aluminum. In metal costs alone, aluminum costs ½ less than Admiralty, ⅓ less than mild steel, ⅙ as much as stainless.

These are actual costs reports from cleaning operations conducted by The Shell Oil Company at *Martinez, California.*

TEST NO.	TUBE SIDE	ESTIMATED SAVINGS (DOLLARS PER YEAR)
15	85 per cent oil, 15 per cent furfural, 305° F	1,000
16	85 per cent oil, 15 per cent furfural, 265° F	800
18	17 per cent oil, 3 per cent water, 80 per cent furfural, 315° F	1,600

ALCOA

knows most about the use and application of aluminum heat exchanger tubes

Alcoa pioneered the use of aluminum in heat exchanger tubes 43 years ago. Although their sale today is limited by government regulation, you will want to start planning with a copy of the booklet, *Alcoa Aluminum Heat Exchanger Tubes.* Write:

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OVER 6 MILLION FEET OF ALCOA TUBES ARE IN USE FOR APPLICATIONS LIKE THESE . . .

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Vapor recovery condensers
Lube oil coolers
Natural gas compressor aftercoolers
Recompressor aftercoolers
Hydrogen sulfide gas coolers
Furfural condensers and heat exchangers
Propane chilling
Wax sweaters
Lean oil—rich oil exchangers
Amine solution coolers
Glycol-amine heat exchangers and reboilers
Jacket water coolers

CHEMICAL

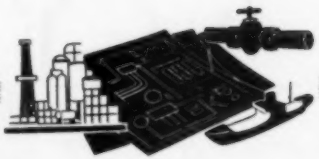
Butanol
Ethanol
Ethylene Glycol
Glycerin
Hydroabietyl
Isopropanol
Methanol
Phenol
Propylene Glycol
Acetaldehyde
Formaldehyde
Furfural
Heptaldehyde
Acetic acid
Stearic, Palmitic, Maleic Oleic acids
Butyric acid
Naphtha
Ricinoleic acid
Acetanilide
Ammonia
Hydrogen Cyanide
Nitric acid (concentrated)
Pyridine
Hydrogen Sulfide
Benzene
Dichlorobenzene
Gelatin
Hydrogen Peroxide
Turpentine
Xylene

Use Alcoa Alclad 3S-H14 Heat Exchanger Tubes with fresh, brackish and salt-cooling waters

Digest of Recent U. S. PATENTS Pertaining to PETROLEUM REFINING

Compiled by DR. HEINZ HEINEMANN

(From the Official Gazette, April 1, 8, 15 and 22, 1952.)



REFINING

U.S.P. 2,591,503. Combustion Catalyst Compositions. R. R. Bottoms to National Cylinder Gas Company.

A non-hazardous, stable liquid combustion adjuvant miscible with hydrocarbon fuels to improve their burning characteristics is composed of 1-15 percent of at least one organo-metallic compound of certain heavy metals and an organic radical having at least two double bonded oxygen atoms attached to C atoms separated by a methylene or substituted methylene group. The organo-metallic compound is dissolved in crystal-free neutral coal tar.

U.S.P. 2,591,583. Rust Preventive. L. E. Moody and J. W. Hand, Jr., to Standard Oil Development Company.

A leaded gasoline fuel contains a lead scavenger agent and 0.03-5 percent of a diamine of the formula $H_2N\text{-}R\text{-}NH_2$, wherein R is an alkyl group with 2-5 C atoms. Rust formation is prevented by this additive.

U.S.P. 2,591,690. Method of Deasphaltizing Oils. K. A. Fischer.

For removing asphaltic-resinous constituents from petroleum oils and oil containing distillation residues, the oil containing material is mixed with hexafluoroxylene and the mixture is heated to 60°-120° C.

U.S.P. 2,592,383. Process for Preparing Heating Oil. L. J. Blatz to Standard Oil Development Company.

A virgin heating oil boiling at 400°-650° F. is extractively sweetened and then blended with a caustic-washed cracked heating oil of similar boiling range. A compatible heating oil blend is obtained.

U.S.P. 2,592,453. Temperature Control of Adsorption Systems. J. P. Morgan and J. A. Patterson to Standard Oil Development Company.

Cyclohexane is separated from normal hexane in a countercurrent absorption-desorption process utilizing downwardly flowing fluidized silica gel in the adsorption zone. Hot desorbed silica gel is obtained at a temperature above that required for adsorption. Details are claimed.

U.S.P. 2,593,128. Process for Sulfuric Acid Recovery. R. H. Felter to California Research Corporation.

Sulfuric acid sludges from petroleum refining having an acid content above 80 percent by weight and a mole ratio of H_2SO_4 to H_2O above 2.5 are cooled to a temperature of 0°-30° F. A solid phase comprising sulfuric acid of more than 93 percent concentration and a liquid phase are formed and separated.

U.S.P. 2,593,561. Method of Preparing Rich-Mixture Aviation Fuel. W. A. Herbst and W. C. Howell, Jr., to Standard Oil Development Company.

A process is claimed for preparing a high-quality, rich mixture aviation fuel from a fractionated aromatic hydrocarbon-containing gasoline fraction, extracting the C_7-C_8 aromatics, removing the ortho-substituted aromatics therefrom and blending the remaining aromatics with aviation gasoline of lower octane number.

U.S.P. 2,593,619. Treatment of Hydrocarbon Oils with an Alkyl Oxalate and an Alkali Alcoholate. J. O. Smith, Jr., and A. R. Jones to Standard Oil Development Company.

Gasoline or cracked petroleum distillate is treated with a small amount of an alkyl oxalate and of an alkali alcoholate. Compounds forming undersirable engine deposits are removed by the treatment.

U.S.P. 2,594,044. Solvent Extraction of Oils with Dimethylammonium Dimethylcarbamate. D. J. Loder to E. I. du Pont de Nemours & Company, Inc.

Mineral oil is refined by extracting it in the liquid state with dimethylammonium dimethylcarbamate and separating the two phases formed, the extract phase of which contains removed impurities.

U.S.P. 2,594,266. Prevention of Rust. F. M. Watkins to Sinclair Refining Company.

Gasoline or other light petroleum distillate of a viscosity not greater than that of gas oil is incorporated with a small amount of ammonium mahogany sulfonates to inhibit rust formation.

POLYMERIZATION AND CONVERSION

U.S.P. 2,591,384. Production of Tri- and Tetra-Isobutylene. R. S. Bowman to Gulf Research & Development Company.

Isobutylene is reacted with di-isobutylene at a temperature of 0°-110° C. in the presence of a BF_3-ether complex catalyst. A mixture of tri- and tetra-isobutylene, useful in the manufacture of motor fuel, is obtained.

U.S.P. 2,592,404. Method for Hydrocarbon Conversion. L. P. Evans to Socony-Vacuum Oil Company, Inc.

A high boiling liquid hydrocarbon charge is contacted with a particle-form solid sorbent material having a temperature below 750° F., i.e., below conversion temperature. Sorption of the liquid into the pores of the sorbent is thus effected. The rich sorbent is mixed with sufficient hot sorbent material of similar type having a temperature substantially above that effecting the desired conversion. The liquid bearing sorbent is thus heated to a temperature suitable for converting at least part of the charge to lower boiling vaporized products.

U.S.P. 2,592,428. Polymerization of Propylene with Liquid Phosphoric Acid. J. D. Kemp and L. F. Brooke to California Research Corporation.

A liquefied normally gaseous hydrocarbon material rich in propylene is passed into a body of liquid phosphoric acid of a concentration of 103-116 percent orthophosphoric acid maintained at a temperature of 225-300° F. and a pressure above 200 psi, at a space velocity above 0.15 volumes of liquid propylene per volume of acid per hour. At least 50 percent of the propylene are converted into liquid polymer.

U.S.P. 2,592,479. Catalytic Contacting Tower. E. L. Sinclair and W. A. Hagerbaumer to Socony-Vacuum Oil Company, Inc.

The construction is claimed of an apparatus for conducting two or more conversion reactions of hydrocarbons in the presence of the same moving stream of particle form solid contact mass material. The apparatus allows a high degree of flexibility in the ratio of hydrocarbon and contact mass.

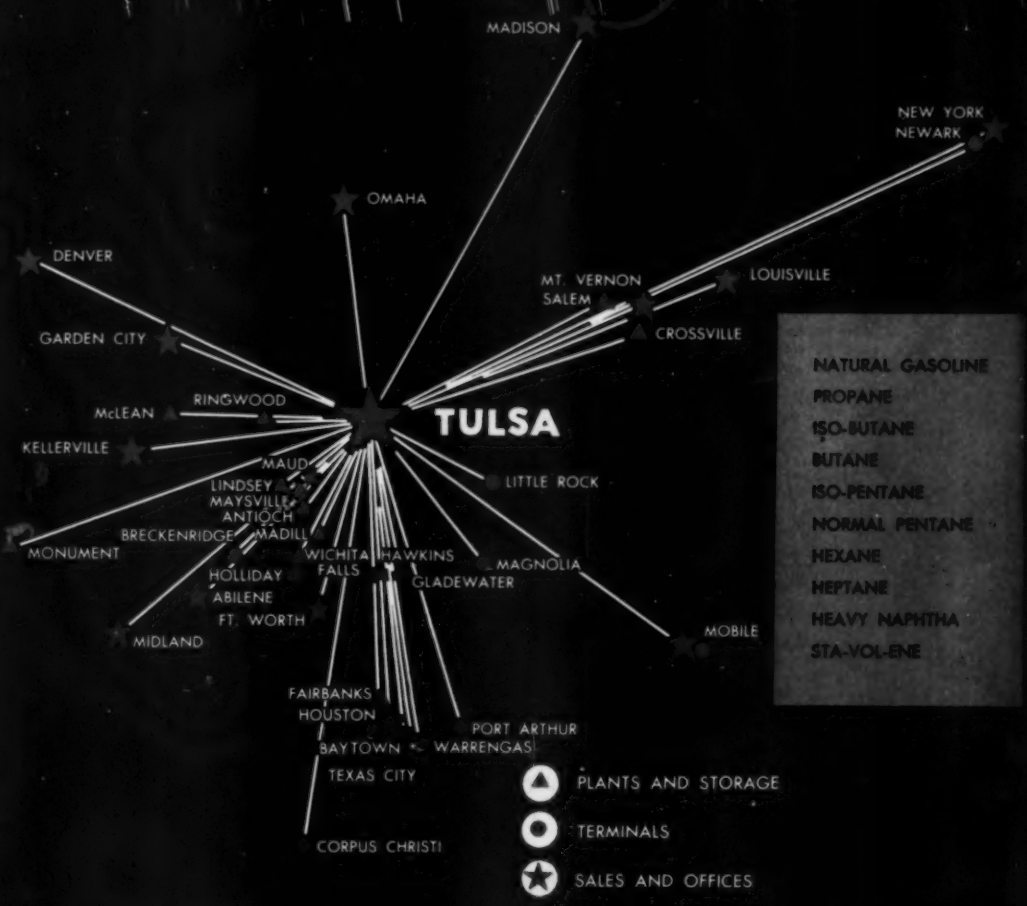
U.S.P. 2,592,526. Process for Polymerizing Ethylene in Aqueous Emulsion. L. Seed to Imperial Chemical Industries, Ltd.

A polymerizable composition comprising ethylene is polymerized at a temperature of 50-400° C. and a pressure exceeding 200 atm. in the presence of water and a polyvinyl alcohol, hydrolyzed polyvinyl acetate or other water-soluble nonionic organic emulsifiers, and a salt of an organic sulfonate or sulfate.

U.S.P. 2,592,740. Catalytic Conversion with Hydrofluoric Acid. J. A. Ridgway, Jr., to Pan American Refining Corporation.

Hydrocarbons boiling higher than gas-

Service *Centers*



NATURAL GASOLINE
PROPANE
ISO-BUTANE
BUTANE
ISO-PENTANE
NORMAL PENTANE
HEXANE
HEPTANE
HEAVY NAPHTHA
STA-VOL-ENE

WARREN

PETROLEUM CORPORATION

TULSA, OKLAHOMA CABLE ADDRESSES: Stavolene, Warren

EXPORT TERMINALS: CORPUS CHRISTI, PORT ARTHUR, BAYTOWN, TEXAS CITY AND WARRENGAS, HOUSTON, TEXAS

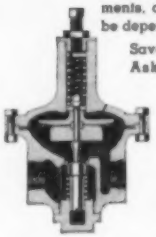
for efficient operation

Clark Pressure Reducing and Regulating Valves

are precision-made for positive pressure control on air, gas or steam lines.

Where different types of equipment, with varying pressure requirements, are operated from a common line, Clark Regulating Valves can be depended on to deliver automatically the "just right" pressure to each.

Save on fuel, maintenance and protect expensive equipment. Ask your Clark representative to specify the right Clark valves for your needs . . . or write us direct.

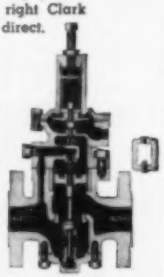


TYPE KRV

Pressure Reducing Valve. Diaphragm Operated-Single Seated Valve. Sizes ½" to 1½" for initial pressures up to 250 P.S.I. Reduced pressures to 85 P.S.I.

TYPE CRV

Pressure Reducing Valve. Integral pilot controlled, piston operated. For pressure control from "dead end" to full capacity. Sizes ½" to 6".



TYPE ORV

Pressure Reducing Valve. ⅜" and ½" Single Seated, Spring Loaded, Diaphragm Actuated. For initial pressures to 250 P.S.I. Reduced pressures to 200 P.S.I.

QUICK-CLEANING STRAINERS

Remove dirt, scale and grit from steam, fluid and gas lines. Sizes ½" to 3" I.P.S. For pressures to 250 P.S.I.

THE CLARK MANUFACTURING COMPANY

1847 East 38th St. • Cleveland 14, Ohio

Patents

oline are converted into lower boiling hydrocarbons of which some at least are unsaturated, e.g., gas oil and kerosene into gasoline, by countercurrently contacting the charge with HF under conditions claimed in detail.

U.S.P. 2,593,338. Contacting Solid Particles with Gaseous Fluids. H. J. Ogorzaly to Standard Oil Development Company.

In a process wherein powdered contact material is maintained in a dense fluidized condition and is withdrawn from the contact zone into a standpipe to form a fluidized dense column producing hydrostatic pressure, the pressure differential during the operation is reduced by a constriction, such as a Venturi-type throat in the line below a slide valve discharging from the standpipe into a stream of carrier vapors or gases.

U.S.P. 2,593,345. Pebble Heating Chamber. S. P. Robinson to Phillips Petroleum Company.

The construction is claimed of an apparatus for heating pebbles and the like.

U.S.P. 2,593,399. Mass Polymerization of Styrene at 285° C. H. F. Park to Monsanto Chemical Company.

Styrene is polymerized in contact with acrylic peroxide at 285° C. in 5-30 minutes.

U.S.P. 2,593,404. Method of Sealing Hydrocarbon Conversion Housings. J. W. Barker to Houdry Process Corporation.

In a hydrocarbon conversion system in which solid contact material is passed cyclically through separate zones wherein this material is contacted with different gases under different gaseous pressures, the contact material is transferred between these zones while maintaining a gas seal therebetween. Details are claimed.

U.S.P. 2,593,495. Art of Applying an Atomized Hydrocarbon Mixture to Contact Material During Passage Thereof Through a Reaction Zone. H. G. Shimp to Houdry Process Corporation.

In hydrocarbon conversions, contact material is admitted at reaction temperature to a reaction zone for downward passage therethrough. At least a part of this material is caused, while following a circumferentially complete path, to diverge from the longitudinal axis of the reaction zone and, after said divergence, is gravitated toward this longitudinal axis as a layer. An atomized hydrocarbon mixture is injected into this layer.

CRACKING AND REFORMING

U.S.P. 2,592,403. Method of Preparing Hydrocarbon Feed Stocks Containing Asphaltic Material for Catalytic Cracking. L. P. Evans to Socony-Vacuum Oil Company, Inc.

A petroleum stock of broad boiling range containing vaporizable fractions, heavy liquid oil, and asphalt fractions is heated to a temperature below that of substantial thermal cracking, but high enough to effect substantial vaporization. The non-vaporized residue is deasphalted and then contacted at conversion conditions with a moving contact material. The vaporized portion of the charge material is also contacted at suitable conversion conditions with this con-

This kind of round-table discussion can HELP YOU GET YOUR PLANT UNDER WAY

Chemical Plants Division is staffed by engineers with years of practical "on-the-job" design and construction experience in such fields as: Chemical Processing, Food Processing, Petrochemicals, Low Temperature Processes, Oil and Gas Operation, Wood Utilization, Waste Recovery and many other industrial projects.

By focusing our composite skills and experience on your problem our engineers are likely to find better methods, better layouts and better equipment to increase your production and reduce costs. Whether it concerns a single piece of equipment, expansion, conversion or modernization of present facilities, building a new plant or development of a new process, we are ready to discuss your problem at any time.

CHEMICAL PLANTS DIVISION
offers you competent experience in

Chemical Processes—Processing plants designed and constructed in accordance with the client's data.

Chlor-Alkali—Complete chlorine and caustic soda plants employing the Mathieson mercury cell process.

Fats and Oils—Units for the extraction and processing of fats and oils into edible and industrial products.

Low Temperature Processes—Plants for the separation of gases into their components by processes of Gesellschaft fuer Linde's Eismaschinen.

Oil and Gas—Gas compressor and treating plants; facilities for distillation, cracking, reforming, polymerization and refining of petroleum.

Resins and Plastics—Plants to produce resins such as alkyd, phenolic, urea, melamine, vinyl, polystyrene, copolymer, and special resins.

Synthetic Fuels and Chemicals—Production of synthetic hydrocarbons and oxygenated compounds based on Fischer-Tropsch, Oxo, and Oxyl synthesis.

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PRECISION BY THE

A Clark compressor on the job is your assurance of dependable performance. Unrivaled engineering and quality construction, literally precision by the ton, make this dependability possible. From massive crankcases to minute governor parts, unequaled precision standards are maintained to assure extra long compressor life.

How are these standards achieved?

1. Clark insists on painstaking care, meticulous, accurate machining of *all* parts affecting the performance and life of the compressor — *no matter what the size or what the function.*
2. Clark has the specialized tools and equipment to produce to unsurpassed, uniformly high precision standards. To meet these standards, Clark has had to build many of its own specialized tools.
3. Clark has the specialized know-how, the skill, the craftsmen. A half century has been devoted solely to designing and precision-building heavy duty compressors for every conceivable need.

The Clark trademark on a compressor is your assurance of extremely long life.

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CLARK compressors

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Final inspection of power piston before lubrizing.

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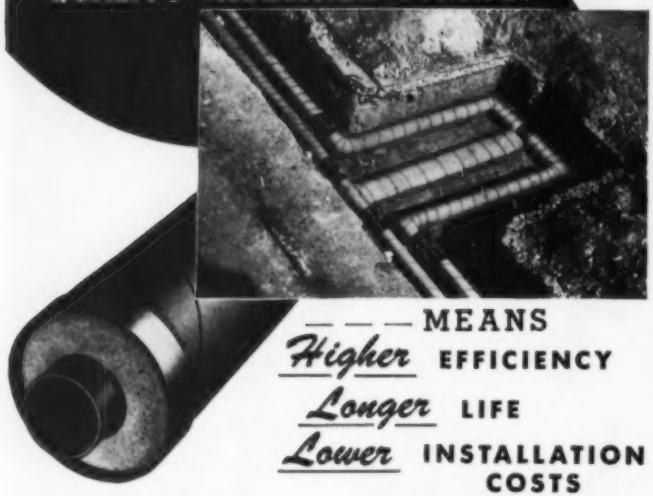
QUALITY INSULATED PIPING



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Higher EFFICIENCY
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Lower INSTALLATION COSTS

There is no stronger proof of Ric-wil quality and dependability than the specification time after time of Ric-wil Systems for heating and process distribution piping in major defense projects, industrial plants, and utility central heating systems.

Engineers like the way Ric-wil Insulated Piping can be quickly adapted and laid out to meet any design or operating conditions. Contractors like the savings in installation possible with these 21-ft. prefabricated units, their easy handling and simple coupling features. Owners have the satisfaction of knowing that a Ric-wil distribution system will provide high thermal efficiency, maximum protection, and long service life.

Condensate return piping and other lines subject to corrosive service may be coated with Ricwilite, a baked-on phenolic resin having outstanding corrosion resistance and durability.

Let a thoroughly experienced representative show you the installation and operating economies possible with Ric-wil on your next insulated piping project.

RIC-WIL TYPE "B" COUPLER

Provides a watertight conduit joint with synthetic rubber gaskets. No conduit welding required, expediting joint closures.

RIC-WIL
INSULATED PIPING SYSTEMS
UNDERGROUND OR OVERHEAD

WRITE FOR . . .
Your copy of Section 480-6. Contains valuable data on pipe selection, flexibility, and expansion.

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AGENTS IN PRINCIPAL CITIES
LEADERS IN INSULATED PIPING PROTECTION

PREFABRICATED INSULATED PIPING

SECTIONAL CONDUIT SYSTEMS

PREFABRICATED MANHOLES

UTILIDOR TYPE CONDUITS

Patents

tact material. The mixed conversion products are separated from the contact material.

U.S.P. 2,592,603. Re-Forming Naphtha Stocks. R. A. Sanford and B. S. Friedman to Sinclair Refining Company.

A naphtha stock is heated to a temperature of 950°-1150° F. in the presence of a high area-activated carbon catalyst containing 1-10 percent of an alkaline compound of an alkali metal at a liquid-hydrocarbon space velocity of 0.5-3.0 and under a pressure of 0.1-1 atm. Reformed hydrocarbons in the gasoline range are recovered.

U.S.P. 2,593,584. Reforming Hydrocarbon Gases in the Presence of a Magnesia Catalyst. C. S. Lynch to Standard Oil Development Company.

A hydrocarbon gas is converted with an oxidizing gas containing a major proportion of CO_2 at a temperature of 1400°-1800° F. with a magnesia catalyst. A gas mixture is obtained containing H_2 and CO in a ratio below 3 : 1.

ISOMERIZATION

U.S.P. 2,591,843. Catalytic Isomerization of Hydrocarbons. J. W. Loy to Phillips Petroleum Company.

Details are claimed of a process for the catalytic isomerization of hydrocarbons, wherein the promoting agent is introduced to the catalyst zone multipointwise, flow-wise, and in controlled variable volume. Coking and deactivation of the catalyst is inhibited.

ALKYLATION

U.S.P. 2,591,367. Alkylation of Isoparaffins with Isomerized Olefins. S. H. McAllister to Shell Development Company.

Hydrocarbon containing an alpha-olefin of at least 4 C atoms is isomerized to the corresponding beta-olefin. A mixture of the latter and an excess of an isoparaffin is alkylated in the presence of a suitable catalyst.

CATALYST PREPARATION, ACTIVATION, AND REGENERATION

U.S.P. 2,590,980. Apparatus for the Catalytic Conversion of Hydrocarbons. G. F. Kuhn to Sinclair Refining Company.

The construction is claimed of an apparatus for regenerating catalyst in the form of beads or pellets to be used in the catalytic conversion of hydrocarbons, such as cracking, hydrogenation, dehydrogenation, or the like.

U.S.P. 2,590,997. Method for Separating Colloidally Dispersed Iron Particles from Organic Liquids. E. Mitchell to Gulf Research & Development Company.

A stable suspension of colloidal iron dispersed in an organic liquid, such as obtained in chemical reactions in the presence of an iron catalyst, is coagulated by addition of a low mole weight, water soluble, aliphatic alphahydroxy carboxylic acid, e.g. lactic acid. The colloidal iron is rapidly coagulated thereby.

U.S.P. 2,591,096. Hydrogen Fluoride

How earnings work to produce more oil

IMPORTANT FACTS FROM THE 1951 ANNUAL REPORT OF STANDARD OIL COMPANY (NEW JERSEY)

IN THE FREE WORLD, people use tremendous amounts of oil. Meeting their needs, rising year after year, has been one of the notable industrial accomplishments of our time.

For example, the peak war effort in 1945 pushed use of oil 23% higher than in 1940. This looked like a mark that would not be topped for years.

But vigorous post-war reconstruction, and expansion of industry, transportation and agriculture, made oil use in 1946 greater even than in 1945. And in 1951 it was 58% higher than in 1946.

To supply this oil has called for great expansion by the petroleum industry. It has meant new wells, pipe lines, storage tanks, refineries, tankships . . . in times of high costs.

The job has required a vast outlay of money, *which has been provided largely by the industry's own earnings.*

How this works out is shown in the case of Standard Oil Company (New Jersey), an American corporation having investments in companies carrying on the varied functions of the oil business in the United States and abroad.

Consolidated net income of Jersey and affiliates for 1951 was $528,461,000. Of this, $278,862,000, or 53%, was used to help provide new equipment.

In the six years since 1945, Jersey and affiliates have spent $2,350,000,000 for replacement and expansion of facilities. Depreciation and depletion reserves provided only 44% of that amount. The largest share of the expenditure was met by the reinvestment of earnings.

During 1951 alone, to do their part in supplying more oil for the free world, companies in which Standard Oil Company (New Jersey) has investments:

Discovered Oil

In the United States, made new oil discoveries in the Williston basin, the Uinta basin, and Texas . . . In Latin America, extended known fields in Venezuela, and opened up a new area in Colombia . . . In the Middle East, Arabian American Oil Company made two important discoveries, one in the offshore waters of the Persian Gulf . . .

Developed Production

In the United States, drilled more wells than in any year since 1937, and greatly expanded secondary recovery operations to get more oil from existing fields . . . In Venezuela, completed 190 producing wells . . . In Canada, increased total producing wells from 844 to 1,140 . . . In the Middle East, Arabian American Oil Company and Iraq Petroleum Company increased production 57% . . .

Expanded Refining Capacity

At Baton Rouge, La., and Everett, Mass., enlarged refineries . . . At Winnipeg, in Canada, opened a new refinery and, at Edmonton, Sarnia, and Vancouver added facilities . . . At Fawley, England, put the largest refinery in the United Kingdom on stream . . . At Antwerp, Belgium, proceeded with field work on a large refinery . . . at Durban, South Africa, started work on a refinery, and at Bombay, India, completed arrangements to build a new one . . .

Expanded Transportation

In the United States, boosted pipe line capacity substantially, particularly in the South . . . Ordered twelve new ocean-going tankships, bringing the post-war total of those purchased or contracted for to 72 . . . Began to bring Western Canadian oil to consumers in the Eastern provinces by means of two large, new Great Lakes tankers, with a third going in service this spring . . . In Iraq, Iraq Petroleum Company brought near completion a new 556-mile pipe line from the oil fields to the Mediterranean. It will permit oil production in Iraq to be more than doubled in 1952 . . .

Advanced Research

Put into the search for new and improved processes and products a total of $23,100,000, one of the largest expenditures for such a purpose by any company . . .

Continued Good Employee Relations

The interest of the company and its employees in maintaining good mutual relationships resulted in another year without strikes or work stoppages in the domestic affiliates. This was an important factor in meeting the increased demand for oil . . .

AS THE FREE WORLD GROWS IN STRENGTH, it calls for more and more oil. So, not just to the 254,000 shareholders who own Jersey, but to people on freedom's side all through the world, the two outstanding facts about our Annual Report for 1951 are: (1) Jersey affiliates again did their part in meeting the growing needs for oil; and (2) the competitive business system that did this job produced the earnings to help meet even greater needs in the future.

FINANCIAL SUMMARY

Standard Oil Company (New Jersey) and Consolidated Affiliates

Total income from sales, services, dividends and interest	$3,863,317,000
Net income	$528,461,000
	or $8.72 per share
Dividends	$249,599,000
	or $4.12½ per share
Wages and other employment costs	$600,500,000
Taxes charged to income	$400,700,000
Other taxes, collected for governments	$329,900,000
Spent for new plants and facilities	$381,824,000
Number of shareholder-owners	254,000
Number of employees	120,000

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STANDARD OIL COMPANY (NEW JERSEY)
AND AFFILIATED COMPANIES

Patents

Recovery. J. E. Penick to Socony-Vacuum Oil Company, Inc.

HF is removed from its anhydrous mixture with low boiling hydrocarbons by contacting this mixture with a HF-acetonitrile complex. The HF present in the mixture is selectively absorbed by this complex.

U.S.P. 2,591,719. Catalyst Regeneration Apparatus. C. C. Peavy and R. M. Shirk to Houdry Process Corporation.

The construction is claimed of an apparatus for contacting gas with a bed of solid particles. The walls of the reactor are protected against high temperatures by minimizing the heat effects occurring in the layer of solid particles adjacent to such walls.

U.S.P. 2,592,016. Double Impregnation Method of Producing a Pelleted Catalyst. W. F. Engel to Shell Development Company.

The desired amount of a compound of a heavy-metal promoter decomposable to the oxide is dissolved in two portions (A and B) of a solvent in such a manner that portion A contains 8-12 parts of this promoter per 100 parts of a relatively inert catalyst carrier and portion B contains the remaining amount of the promoter. The carrier is impregnated with portion B, dryed and calcined at a temperature sufficient to decompose the impregnant compound. The resulting material is impregnated with the portion A, dryed at a temperature below that decomposing the impregnant compound. The material thus obtained is pressed into pellets and then calcined at such decomposing temperature.

U.S.P. 2,592,121. Regeneration of a Moving Bed Catalyst at a Uniform Burning Rate. J. A. Crowley, Jr., to Socony-Vacuum Oil Company, Inc.

Details are claimed of a method for regenerating a spent particle form contact material bearing carbonaceous deposits. The method allows to remove sufficient heat of combustion from the material treated to control the temperature of this material within predetermined limits.

U.S.P. 2,592,775. Preparation of Catalyst Containing Silica and Alumina or Magnesia or Both. J. P. West to Universal Oil Products Company.

An alkyl ortho-silicate is reacted with a monobasic aluminum or a magnesium organic acid salt or a mixture thereof, at a temperature of 150°-300° C. and under a pressure sufficient to maintain at least a portion of the reaction mixture in liquid phase. The calcined product forms a composite catalyst.

U.S.P. 2,593,097. Zirconium Oxide-Silicon Oxide Silver Catalyst Support and Process Using Same. W. E. Burt, J. T. Burt, and W. B. Ligett to Ethyl Corporation.

A thermally stable oxidation catalyst containing silver has a support consisting of 30-70 percent ZrO_2 and 70-30 percent SiO_2. The catalyst is readily fluidizable and is composed of a special particle size mixture. This catalyst is particularly useful in the production of ethylene oxide from ethylene.

U.S.P. 2,593,098. Organic Peroxides as Promoters for Silver Oxidation Catalysts and Process Using the Same. W. E. Burt to Ethyl Corporation.

An oxidation catalyst, particularly useful in the production of ethylene oxide from ethylene, consists of 4-50 percent silver, a support, and 0.5-4 percent of an organic peroxide, e.g. benzoyl peroxide.

U.S.P. 2,593,099. Magnesium Oxide-Barium Oxide Silver Catalyst Support and Process Using the Same. G. Calingaert to Ethyl Corporation.

A silver containing oxidation catalyst, useful in the production of ethylene oxide from ethylene, has a refractory support consisting of 10-20 percent BaO and 70-85 percent MgO, the balance being incidental impurities.

U.S.P. 2,593,100. Silver Catalyst Supported on a $MgO-Al_2O_3$ Spinel. G. Calingaert to Ethyl Corporation.

An oxidation catalyst containing 4-50 percent silver has a support consisting of a spinel having $MgO \cdot Al_2O_3$ as the principal ingredient.

U.S.P. 2,593,156. Ethylene Oxidation and Silver on Magnetite as Catalyst Therefor. F. W. Lamb to Ethyl Corporation.

On a support consisting of Fe_3O_4 of spinel crystal structure is deposited an amount of 4-20 percent Ag_2O. The catalyst is particularly useful in the production of ethylene oxide from ethylene.

U.S.P. 2,593,720. Supported Phosphoric Acid Catalyst Containing a Pitch Resin Binder and Its Preparation. M. S. Bielawski to Universal Oil Products Company.

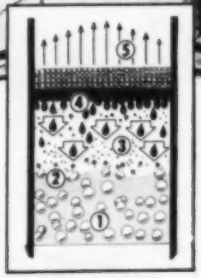
Fifty-75 percent by weight of a phosphoric acid, 20-49.5 percent of a siliceous adsorbent, and 0.5-5 percent of a pine wood pitch resin insoluble in paraffinic hydrocarbons are mixed. The resulting composite on drying and calcining forms

From the recovery of liquids entrained in discharge gases to the removal of contaminators to further processing, these simple knitted-wire pads are daily contributing to greater on-grade throughput, increased efficiency and lowered costs in refineries from coast to coast.

Metex Mist Eliminators do just one thing — remove liquids entrained in gases. The diagram shows how they are doing it in stills, towers, cats, knock-outs, evaporators and other vessels.

Efficiencies 95% and better • Little if any pressure drop • Easily installed in existing equipment • Made of practically any metal • No valves or moving parts to service.

Worth looking into, isn't it? For full information, write for free copy of "Metex Mist Eliminators," an 8-page brochure that's packed with facts.



HOW IT WORKS

(1) Gas passes through liquid. (2) Bursting gas bubbles produce fine spray of liquid droplets. (3) Droplets are entrained in rising stream. (4) Droplets coalesce on knitted-wire surfaces to form large drops that fall back against the flow. (5) Gas passes on, freed from entrainment. The liquid is returned.

METAL TEXTILE CORPORATION

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METEX

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TNEMEC PRIMERS KILL RUST!

THE first step in preserving steel with paint is applying the prime coat. Its primary job is to prevent and kill rust action. TNEMEC Primers do just that, by creating a neutral condition on steel surfaces, changing active rust and corrosive agents into an inactive neutral compound.

The second step is applying the finish coat that will provide protection against the specific exposure hazards involved.

WHAT IS YOUR EXPOSURE HAZARD?

Is it the humid, salt-air atmosphere of coastal areas? Is it the acid-laden atmosphere found in and around industrial plants, refineries, steel mills, the processing industries, etc? Is it submersion in sewage treating vats, in salt brine, or in fresh water tanks?

No matter what your problem is, there is a TNEMEC Finish Coat to solve it. And remember . . . you will always save many maintenance dollars by doing the job *right*.

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(TEE-NEE-MIK)

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Is there a gas we haven't met?

Our Carrier Centrifugal Compressors have compressed more different gases on the job than those of any other manufacturer. We think experience like that is important to you.

Maybe you work with butane or propane. Ethylene, methylene chloride, ethane or chlorine. Air, oxygen, sulphur dioxide or hydrogen sulphide. All of these and many more have been used in our Centrifugal Compressors at some time or other during the past thirty years. So there's a lot of experience for you to draw upon when you call on Carrier.

Carrier Centrifugal Compressors are available in standard designs from 2000 to 40,000 cfm, with three to seven wheels. In most cases they need no individual engineering. And they're built from standard, pretested components — you're sure of good performance right from the start.

There's a lot more to our Centrifugal Compressor story, of course. Why not consult the Carrier office nearest you? Or write Carrier Corporation, Syracuse 1, New York, for the catalog, "Centrifugal Compressors for Industry."

Carrier

CENTRIFUGAL COMPRESSORS

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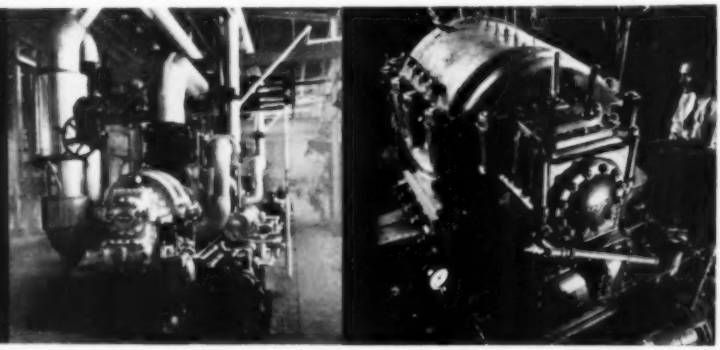

Carrier has built more multi-stage Centrifugal Compressors than any other manufacturer. Here is one of them (left) on the job at a petroleum company. Skilled workmanship, precision inspections (right) and grueling tests make Carrier Centrifugal Compressors the most dependable you can buy.

a catalyst useful in the polymerization and other conversion of olefins.

HYDROGENATION, DEHYDROGENATION, AROMATIZATION

U.S.P. 2,590,869. Manufacture of Gas. W. O. Keeling to Koppers Company, Inc.

Synthesis gas is produced from hydrocarbon gas by first passing refractory granules downwardly through a heating zone while hot combustion products are passed upwardly therethrough. The hydrocarbon gas is then passed over the heated granules together with steam. Further details are claimed.

U.S.P. 2,590,971. Hydrogenated Vinylcyclohexenedimer. H. L. Johnson and F. J. Bondhus to Sun Oil Company.

A dimer of vinylcyclohexene is subjected to the action of hydrogen in the presence of Raney nickel at a pressure of 2000 psi. and a temperature of 100-175° C. until hydrogenation ceases. A hydrogenated vinylcyclohexenedimer is formed which is a colorless oil of the formula, $C_{16}H_{36}$, has the b.p. 121-2° C. at 8 mm. Hg, and a refractive index $n_D^{25} = 1.5112$.

U.S.P. 2,591,687. Process for the Manufacture of Synthesis Gas. D. B. Eastman, E. M. Barber, and B. Reynolds to The Texas Company.

Synthesis gas is produced by partial combustion in the cylinder of an internal combustion engine of a hydrocarbon fuel with an oxygen-containing gas containing at least 90 percent oxygen by volume. Details of the process are claimed.

U.S.P. 2,591,699. Vapor Phase Treatment of Combined Gasoline and Water Phases of Synthesis Product with a Basic Compound. H. V. Hess, G. B. Arnold, and M. L. Drabkin to The Texas Company.

The reaction mixture of a Fischer-Tropsch synthesis, containing hydrocarbons, oxygenated organic compounds, and water, is separated into a gas, a water, and an oil phase. The oil phase is fractionated into a gasoline and a gas oil fraction. The gasoline fraction is combined with the water phase. The resulting combined phase is contacted in vapor state at a temperature of 500-1000° F. with a solid basic alkali metal or alkaline earth metal compound for hydrolizing esters present and decarboxylating acids. The composite is then again separated into a gaseous fraction, a water phase, and a gasoline fraction. Alcohols and ketones are separately removed from the water phase and the gasoline fraction.

U.S.P. 2,591,700. Preparation of Synthesis Gas. L. Jacolev and I. F. German, Jr., to The Texas Company.

Details are claimed of a process for producing synthesis gas by partial combustion of a stream of gasiform hydrocarbon.

U.S.P. 2,592,589. Production and Separation of Isomeric Isopropyl Naphthalenes. J. E. Nickels to Koppers Company, Inc.

A mixture of alpha- and beta-isopropyl naphthalenes, as obtained by alkylating naphthalene under high pressure with propylene in liquid phase at a tem-

TYPE 1-B
Meets Most Requirements

- For light hydrocarbons at pressures up to 500 psi.
- Eliminates leakage and fire hazard on your process, vertical and split-case centrifugal pumps.
- Balanced washer construction means low friction, minimum wear, maximum life.

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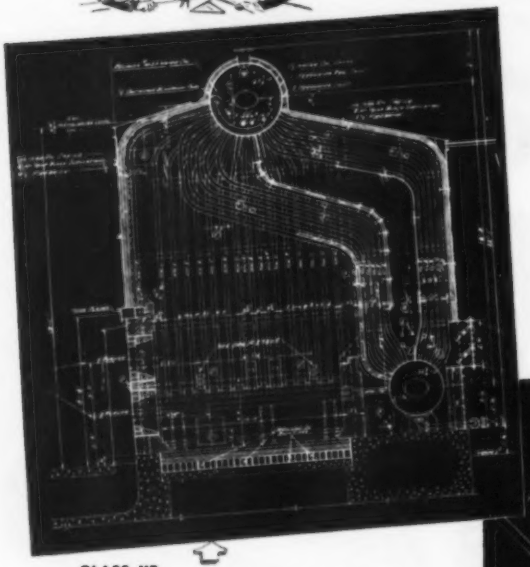
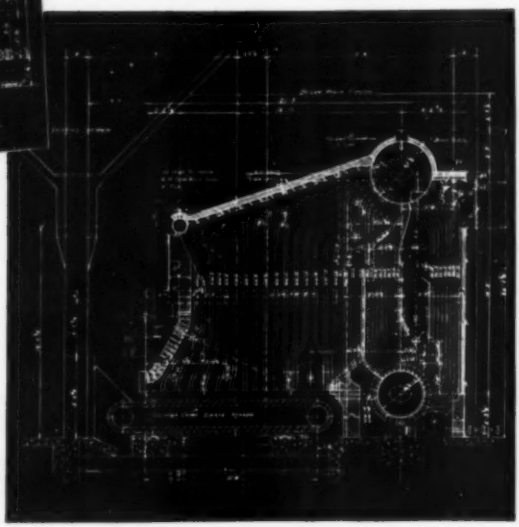


CLASS VF
A 22,000 pounds steam per hour unit installed at Indiana Farm Bureau Refinery, Mt. Vernon, Ind.



CLASS VS
The Seelbach Hotel, Louisville, Ky. is served by this 50,000 pounds steam per hour boiler.

A wide variety of industrial plants and other users of steam for power, processing, or heating have found these efficient Vogt Two-Drum Type Boilers to be the answer to their diverse steam generating requirements.

Class VF units provide maximum capacity in limited floor space and head room, while Class VS is best adapted to installations not having such restrictions. Each has a large furnace volume and a high ratio of radiant heating surface. The furnace design assures proper combustion of fuels fired in suspension or with various type of stokers.

A bulletin with general information and showing typical installations is available on request.

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perature of 150-300° C. in the presence of activated alumina-silica catalyst, is dehydrogenated to obtain a mixture of alpha- and beta-isopropenyl naphthalenes. These products are separated by distillation. The separated products are separately hydrogenated to obtain the alpha- and the beta-isopropyl naphthalene, separately.

U.S.P. 2,592,765. Dehydrogenation of Hydrocarbons. C. L. Thomas and J. C. Morrell to Universal Oil Products Company.

Hydrocarbons are contacted under dehydrogenation conditions with a composite catalyst comprising 50-90 percent of Al_2O_3, 5-30 percent of kaoline or montmorillonite clay, and 4-20 percent of an oxide of a metal of the left-hand columns of the periodical groups V and VI. Dehydrogenation is effected.

U.S.P. 2,593,159. Processing of Synthetic Hydrocarbons. I. L. Malm to Cities Service Oil Company.

Details are claimed of a process of purifying a mixture of synthetically produced materials including hydrocarbons, oxygenated organic compounds and water by fractional distillation and further treatment of the fractions obtained.

U.S.P. 2,593,250. Hydrocarbon Synthesis. J. F. Black and K. K. Kearby to Standard Oil Development Company.

CO and H_2 are contacted in synthesis proportions and at synthesis conditions with catalyst particles containing ferro-silicon from which 1.5-3 percent by weight of silicon (based on the total catalyst) has been removed by etching with a caustic alkali solution. Normally liquid hydrocarbons are recovered. The catalyst may be used in fluidized state.

U.S.P. 2,593,446. Production of Cyclic Monoolefins. H. Heinemann to Houdry Process Corporation.

Monoolefins are obtained in high yields from methylcyclopentane by catalytic dehydrogenation over Cr_2O_3-Al_2O_3 catalysts in the presence of 0.5-4 percent (by weight of the methylcyclopentane) of an added aromatic hydrocarbon, such as benzene. Coke formation during the catalytic dehydrogenation is substantially reduced by said additive.

DESULFURIZATION

U.S.P. 2,591,525. Process for the catalytic Desulfurization of Hydrocarbon Oils. W. F. Engel and P. van't Spijker to Shell Development Company.

For desulfurizing a hydrocarbon oil boiling above the gasoline range a lower-boiling non-paraffinic hydrocarbon oil is added in an amount sufficient to reduce the critical temperature of the resulting mixture to at least 20° C. below the operating temperature. The mixture is then contacted with a sulfactive hydrogenation catalyst, such as a molybdenum oxide-cobalt oxide-alumina catalyst at a temperature at least 20° C. above the said critical temperature and between 325-450° C. while compressed to a density of at least 0.25 g./cc. The lower boiling oil is then separated from the desulfurized oil.

U.S.P. 2,591,946. Sweetening High-Boiling Petroleum Distillates. J. H. Krause and T. B. Tom to Standard Oil Com-

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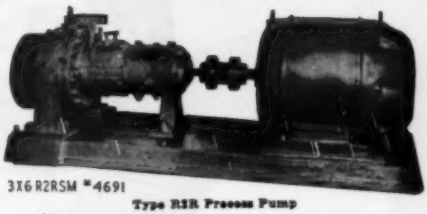
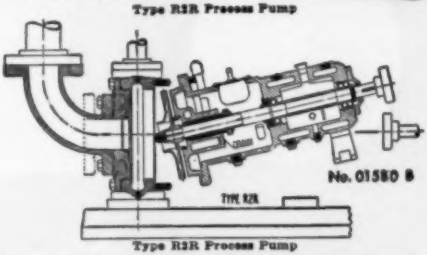
Type R2R Centrifugal Process Pumps



3X6 R2RSM #4691

Type R2R Process Pump



Type R2R Process Pump

DISASSEMBLY: The Type R2R process pumps can be disassembled without disconnecting the suction and discharge piping. By first removing the spacer from the spacer type coupling, and unbolting the casing from the cradle the entire cradle and complete rotating element can be removed without disturbing the suction and discharge piping.

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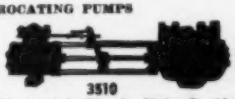

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pany of Indiana.

A sour hydrocarbon distillate is treated with 1-15 percent by volume of an aqueous KOH solution of 50-60 percent concentration containing 0.004-0.1 percent by weight of Cu in the form of an active copper compound as an oxidation catalyst. Free oxygen containing gas is introduced in an amount about stoichiometrically equivalent to the amount of mercaptans present in the distillate at a contacting temperature of 80-125° F. The mercaptans are removed without excessive color formation.

U.S.P. 2,592,523. Removal of Hydrogen Sulfide and Mercaptans from Gases or Liquids Such as Petroleum or Petroleum Fractions. G. W. Ayers, M. J. Geerts, and W. A. Krewer to The Pure Oil Company.

Hydrocarbons containing H_2S or mercaptan are contacted with a modified resin obtained by reacting a synthetic resin, such as a methacrylate, vinyl or vinylidene chloride + acetate, or an alkyd resin, with an amine. The amine groups are attached to the resin molecules through alkoxy chains. The acidic sulfur compounds are retained by the modified resin and may be recovered therefrom.

U.S.P. 2,593,464. Process for Sweetening Hydrocarbon Oils. J. H. Krause to Standard Oil Company of Indiana.

Sour petroleum oils are intimately contacted in the liquid state in the presence of free oxygen at a temperature of 190-230° F. with a catalyst comprising copper fluoride and an inert adsorbent material and at least 8 percent by weight of water. Sweetened oil is recovered.

U.S.P. 2,593,761. Reducing the Mercaptan Content of Petroleum Distillates with a Hydroperoxide. W. W. Johnstone to Universal Oil Products Company.

Sour petroleum distillate is treated with tertiary butyl hydroperoxide or cumene hydroperoxide to reduce its mercaptan content.

U.S.P. 2,593,851. Method of Removing Mercaptans from Hydrocarbons. R. H. Cool to Cities Service Refining Corporation.

A mercaptan containing stream of hydrocarbon oil is treated with methanol and an aqueous NaOH solution. The methanol-caustic solution is continuously removed from the hydrocarbon oil stream. Mercaptans and dissolved hydrocarbons are separated from the said solution. 50-90 percent of the removed mercaptan-hydrocarbon mixture is recycled to the hydrocarbon oil stream prior to its treatment to recover the previously dissolved hydrocarbons.

PETROCHEMICALS

U.S.P. 2,591,498. Process for Brominating Xylene. J. L. Betts, Jr., and A. L. Chaney to Standard Oil Development Company.

At least one isomer of xylene is contacted with bromine in the presence of an iron catalyst at temperatures of 0-150° F. and pressures of atmospheric to 50 psi. Bromo xylene and HBr are formed. At least one mole of the HBr is contacted with a C_4 or C_5 diolefin at temper-

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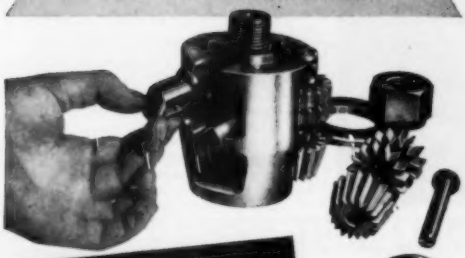

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3. **Faster Cutting Speeds.** The cutter pins revolve freely, new pin bearings reduce surface wear on the wheels — less friction all around.

4. **Low, Easy Maintenance.** Self-aligning bearings are replaced with just a twist of the wrist. One nut opens the whole assembly . . . saves user's time . . . cuts downtime for tube cleaning.

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6. **Extra Expansion.** The special cutter pin bearing provides for greater radial expansion . . . permits removal of deposits of more variable thickness . . . assures more thorough cleaning.

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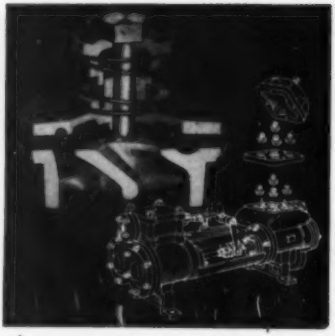

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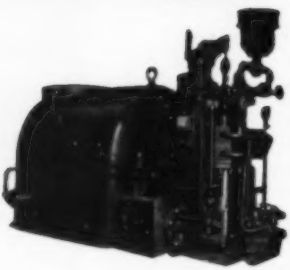

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atures of —40° to 100° F. and pressures of 0-50 psi. The product here obtained is returned to the xylene brominating step. A lead scavenging agent is obtained.

U.S.P. 2,591,710. Production of Fused Cyclic Thiophene Compounds. H. F. McCleary and L. W. Devaney to The Texas Company.

Carbocyclic and heterocyclic hydrocarbons containing a saturated alkyl side chain of at least 2 C atoms and a hydrogen atom on a nuclear C atom adjacent to said side chain are reacted with H_2S, or volatile thermally labile sulfide, or mixtures thereof, in the presence of a solid catalyst, e.g., an oxide or sulfide of a group VI metal on a surface-active carrier, at a temperature of at least 700° F. Fused cyclic thiophene derivatives are formed.

U.S.P. 2,591,841. Hydrohalogenation of Unsaturated Conjunct Polymers. C. B. Linn to Universal Oil Products Company.

An addition complex of HF and a polyolefinic cyclic hydrocarbon is reacted with HCl, HBr, or HI. The corresponding halides are formed.

U.S.P. 2,592,089. Manufacture of Mercaptans. P. F. Warner to Phillips Petroleum Company.

In a process for the production of stable aliphatic mercaptans from olefinic hydrocarbons, particularly from a mixed propylene-butylene polymer, boiling in the range of 320-400° F. and comprising a plurality of isomeric olefins and oxygen-containing compounds, the charge material is first treated with a solid adsorbent to remove said oxygen compounds and then with H_2S in the presence of a mercaptan-synthesis catalyst under certain conditions.

U.S.P. 2,592,365. Condensation Process. C. Weizmann to Polymerizable Products, Ltd.

Cyclopentadiene, indene, fluorene, or benzologs of the latter are condensed with aldehydes or ketones containing no unsaturated aliphatic groups in the presence of the solid very finely divided system obtained by the interaction of KOH and an excess of an organic substance containing two ether forming oxygen atoms separated from each other by 1-2 C atoms.

U.S.P. 2,592,977. Production of Butadiene Monochlorohydrin. W. L. Towle to Columbia-Southern Chemical Corporation.

Hypochlorous acid solution containing less than 50 g. of HOCl per liter of the solution is mixed under vigorous agitation with butadiene dissolved in an aqueous solution of butadiene monochlorohydrin at a temperature below 15° C. The mole ratio of butadiene to its monochlorohydrin added is maintained in excess of 0.1 and the mole ratio of butadiene in solution to the hypochlorous acid in excess of 1.3.

U.S.P. 2,593,440. Manufacture of Carboxyl Compounds. H. J. Hagemeyer, Jr., to Eastman Kodak Company.

A lower aliphatic olefin is reacted with CO and water and/or a lower aliphatic acid at a temperature of 150-400° C. and a pressure of 40-700 atm. in the presence

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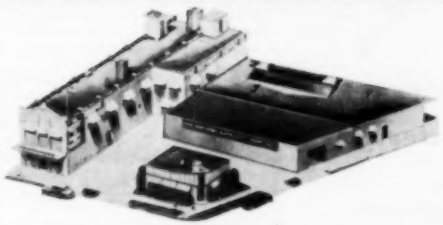

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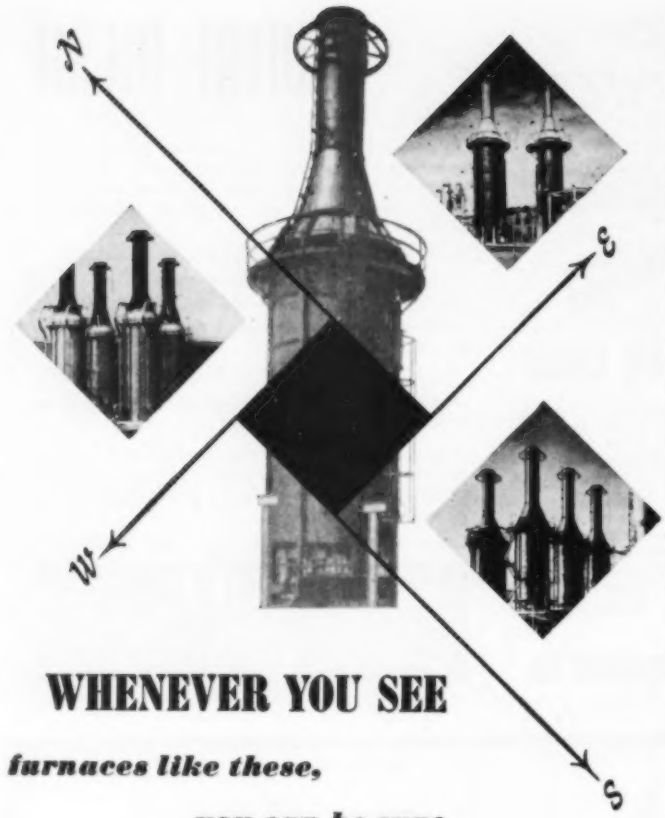

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of a catalyst generated from a three-component mixture of (1) a halide of a carbonyl forming metal from group VIII of the periodic system, e.g., nickel hexamine chloride; (2) Ni or Co as an acceptor; and (3) an alkali metal halide promoter, e.g. NaI.

HEAVY OILS AND WAXES

U.S.P. 2,590,872. Method and Apparatus for Clay Treating Oil. W. W. Kraft to The Lummus Company.

A lubricating oil is contacted with a decolorizing and stabilizing clay adsorbent by introducing an inert gas below the level of a mixture of oil and adsorbent in a closed vessel to strip lighter gases from the oil and to maintain the adsorbent in suspension, and by further treating the mixture.

U.S.P. 2,590,923. Production of Drying Oils. H. S. Bloch and R. C. Wackher to Universal Oil Products Company.

An olefin with at least 3 C atoms is reacted with an unsaturated polar compound of the formula R-Ar-Q wherein Ar is an aromatic radical, R is an alkenyl group, and Q is H, or a halogen atom, an alkyl, alkenyl, carboxylic acid, or sulfonic acid group, at a temperature of 0-175° C., in the presence of a HF catalyst until a mixture of saturated hydrocarbons and polyunsaturated organic compounds is formed. A drying oil with more C atoms than the charge olefin is recovered from the HF phase.

U.S.P. 2,591,570. Cutting Oil. S. Manilych and L. L. Lambert to Socony-Vacuum Oil Company, Inc.

A compound oil, useful as cutting oil, consists of a mineral lubricating oil containing at least 0.8 percent non-corrosive sulfur and 0.1-10 percent of commercial hydroabietyl alcohol to increase drill life.

U.S.P. 2,591,577. Lubricating Oil Containing Disulfide Derivatives of Organo-Substituted Thiophosphoric Acids. J. P. McDermott to Standard Oil Development Company.

A mineral oil contains 0.01-2 percent by weight of a compound of the formula: $ROCH_2CH_2O\backslash S \quad S/OCH_2CH_2OR$ $ROCH_2CH_2O/P\text{-}S\text{-}S\text{-}P\backslash OCH_2CH_2OR$ where R is a phenyl or tolyl radical. The additive is effective as antioxidant.

U.S.P. 2,591,586. High-Temperature Lubricating Greases. A. J. Morway and A. H. Matuszak to Standard Oil Development Company.

A mineral lubricating oil is thickened to grease consistency with a combination of certain amounts of a metallic soap of a saturated fatty acid with 12-22 C atoms and the reaction product of a metal hydroxide and acrolein or its dimer.

U.S.P. 2,591,630. Brick Grease Composition. L. W. Sproule and L. F. King to Standard Oil Development Company.

A block lubricating grease for high temperature operation consists of certain amounts of mineral lubricating oil of viscosity 80-125 S.S.U. at 100° F. and such of viscosity 2000-5000 S.S.U. at 100° F. blended to give overall viscosity of 125-500° S.S.U. at 100° F., and soda base soap.

After two years of development and test work confirmed in the operation of the large West Texas installation pictured below,

HUDSON presents the

Combin-aire*

A New Type Cooling System Integrated for All Process Plant Cooling Services, Combining the Economical Maximum Use of Air With Minimum Use of Water.

In the COMBIN-AIRE the use of air for cooling is extended to include low temperature cooling services previously necessitating water cooling because of high ambient air temperature. The COMBIN-AIRE allows the use of air-cooling for total heat dissipation in all services.

The COMBIN-AIRE is a combination of a HUDSON water cooling tower with HUDSON air-cooled exchangers housed in one integrated structure. During periods of high ambient temperature the inlet air is first drawn through water at the bottom of the cooling tower, reducing the air to near wet bulb temperature, at which temperature it contacts the air-cooled exchangers. During periods of low ambient temperature the inlet air is used directly in the air-cooled exchangers and no water is evaporated in the cooling tower.

When water in good quantity and quality is not available the COMBIN-AIRE has manifest advantages over any alternative combination of cooling equipment.

Even when ample water is available and water treatment costs are low, comprehensive comparisons will frequently indicate overall advantages of the COMBIN-AIRE system.

*** The COMBIN-AIRE unit is protected by United States patents**

COMBIN-AIRE ADVANTAGES

- **LOW WATER CONSUMPTION.** No water is used during cold weather.
- **NO TREATMENT NECESSARY** for cooling tower water.
- **NO WATER LOSS** as spray or mechanical carryover.
- **NO CONDENSATION** from effluent air.
- **MINIMUM PIPING.** COMBIN-AIRE may be installed immediately adjacent to other process equipment. Use of tubular water cooled equipment for final coolers unnecessary.
- **CLEAN AIR TO AIR-COOLED UNITS.** During hot season air is water-washed removing dust, sand and insects.

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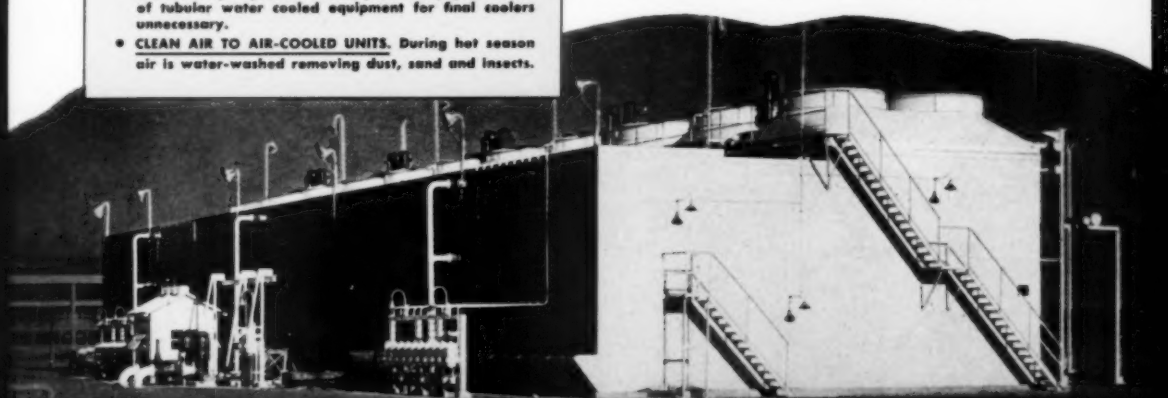
FAIRVIEW STATION • HOUSTON, TEXAS



This COMBIN-AIRE unit operated by the Plymouth Oil Company at their Iowa Park, Texas plant is one of the units [illegible] from oil absorption and fractionating plant streams, a total heat load of about 70 million Btu per hour.

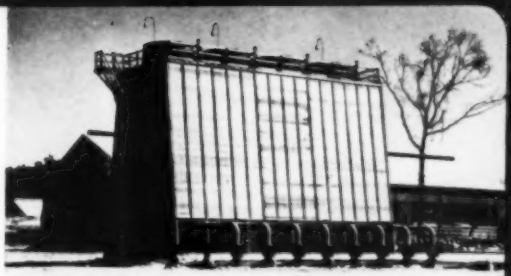
HUDSON

Top Performance

COOLING EQUIPMENT

WATER COOLING TOWERS

Beauty and utility have been successfully combined in the HUDSON "TP" design. These Top Performance cooling towers embodying new but proven advancements in water cooling design, result in lower installation and operating costs for a given guaranteed performance.

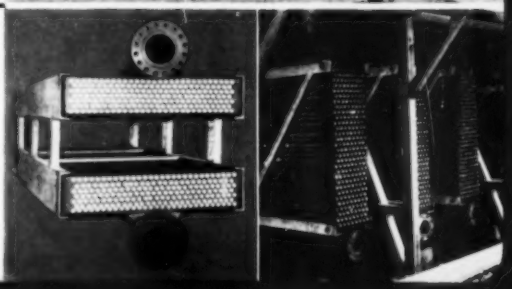


SOLO-AIRE UNITS

HUDSON SOLO-AIRE UNITS for jacket water cooling, gas cooling, steam condensing and hydrocarbon vapor condensing have found wide use, particularly where suitable cooling water is impossible or expensive to obtain. Even where adequate quality and quantity of water is available there are conditions under which these units have marked advantages over alternative cooling methods. Designs are available for pressures up to 5,000 pounds per square inch.

ATMOSPHERIC SECTIONS

These units are for use where water serves as cooling medium. They may be mounted vertically or horizontally, under cooling tower or submerged in water.



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FAIRVIEW STATION • HOUSTON, TEXAS

Patents

U.S.P. 2,591,651. Stabilized Organic Compositions Containing Bis (Hydroxy Alkoxy Phenyl) Alkanes. D. W. Young to Standard Oil Development Company.

Lubricating oil, grease, drying oil, wax, cracked gasoline and mineral oil are protected against oxidative deterioration by addition of a minor amount of a bis (2-hydroxy-5-alkoxy phenyl) alkane.

U.S.P. 2,592,204. Mineral Oil Composition. J. F. Socolofsky and R. V. White to Socony-Vacuum Oil Company, Inc.

A mineral oil contains a minor proportion of an ester product obtained by reacting malic acid with a C_8-C_8 aliphatic alcohol and with an aliphatic alcohol of at least 12 C atoms in a certain mole proportion under special conditions and treating the resulting reaction mixture with ammonia or organic amines. The additive prevents rusting and staining of ferrous metal surfaces in the presence of salt water.

U.S.P. 2,592,435. Decomposition Product Deposit Reduction. A. E. Lacomblé to Shell Development Company.

A mineral lubricating oil or a gasoline fuel contains a minor amount of an oil-soluble aliphatic nitramine, such as an N- unsubstituted hydrocarbon nitramine or dicyclohevyl nitramine. The additive reduces the formation of deposits.

U.S.P. 2,592,490. Method of Dewaxing Oil and Continuous Rotary Filter Therefor. J. P. Thompson to Socony-Vacuum Oil Company, Inc.

To remove wax from an oily feed slurry, a wax filter cake is formed upon a traveling surface within the closed chamber of a continuous filter. The emerging cake is dried, sprayed with a wash liquid and then subjected to a secondary spraying with freshly distilled solvent. The first wash liquid is the oil-solvent filtrate obtained in the secondary spraying. A rotary drum filter of special construction is preferably used for forming the wax cake.

U.S.P. 2,592,497. Extreme Pressure Lubricant. W. E. Waddey and E. B. Cyphers to Standard Oil Development Company.

A lubricating oil base stock is blended with a certain amount of a 50 percent oil concentrate of P_2S_5 treated degras of special combination. The additive imparts extreme pressure properties to the lubricant.

U.S.P. 2,592,624. Cutting Oil Concentrate and Method of Making Same. F. Veatch and J. G. Partch to The Standard Oil Company of Ohio.

A hydrocarbon oil of cutting oil viscosity contains a "motor polymer"-sulfur monochloride reaction product obtained by a special method. The cutting properties of the oil are improved by the additive. The "motor polymer" is a polymerization product of C_3-C_5 olefins.

U.S.P. 2,593,381. Stabilized Paraffin Wax Compositions. D. W. Young to Standard Oil Development Company.

A paraffin wax containing 0.3-0.65 percent by weight of oil is mixed under mechanical agitation with 0.2-0.4 percent of styrene isobutylene copolymer of 50-60 percent styrene content at a temperature above the m.p. of the paraffin wax. A wax composition is obtained which has the properties of wax containing less than 0.3 percent of oil.

U.S.P. 2,593,496. Addition Agent and Mineral Oil Lubricant Compositions Containing the Same. H. G. Smith and T. L. Cantrell to Gulf Oil Corporation.

A mineral lubricating oil contains a minor amount of a product obtained by heating a paraffinic base lubricating oil with P_2S_5 with a surface active silica-containing catalyst below cracking temperature and further reacting the resulting product at a temperature of 300-400° F. with an ester of the formula: $R\text{-}C\text{-}O\text{-}R_1$ wherein R and R_1 are aliphatic radicals at least one of which is olefinic, and the sum of C atoms being at least 16. The additive confers improved bearing corrosion-inhibiting properties on the lubricant.

Advertising Council Launches Campaign for More Engineers

A current critical shortage in the United States of engineering manpower for industry and the defense effort has prompted The Advertising Council to accept an advertising campaign to urge qualified high school students to consider engineering as a career. The request for the campaign came from the Engineering Manpower Commission of the Engineers Joint Council. To help meet the situation, the Council's campaign will point out to high school students and their parents the opportunities that exist in engineering today and in the years to come, and the advantages of engineering training in qualifying young men for positions of leadership in many fields.

KERRIGAN a Great Name in Grating

With the WELD that Never Fails!

Kerrigan grating is a one-piece INSEPARABLE unit. Bearing bars and cross-bars are WELDFORGED by Kerrigan's exclusive process into ONE PIECE. Resulting grating is a strong, anti-slip, easy-to-clean grating that affords maximum light and ventilation, a minimum of installation and maintenance expense, and long years of trouble-free use.

BONDERIZED for rust resistance and extra protection against corrosion! Holds paint to metal for durable finishes.

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and for a copy of "A PICTURE STORY OF KERRIGAN" which shows how KERRIGAN Weldforged steel grating is custom engineered . . . and how Kerrigan's Never-Fail Weld stands up under the severest kind of punishment. Just write on your letterhead for free copy.

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Eagle-Picher Insulations offer more heat-conserving efficiency per dollar

Eagle-Picher Industrial Insulations are the natural choice of smart-thinking purchasing agents, plant engineers and other executives who are concerned with production efficiency and economy. They rely on Eagle-Picher Insulations to cut costs . . . to provide equipment with the highest possible thermal efficiency . . . to help guarantee precise temperature control.

EAGLE EP PICHER

Eagle-Picher Insulations are top-flight performers every time!

1 **You save time, power and money with this hard-working team* of outstanding insulations:**

Insulating Felts • Supertemp Blocks • Blankets • Loose Wool • Pipe Covering • Stalastic • Insulating Cements • Fireproofing Cement • Diatomaceous Earth Block.

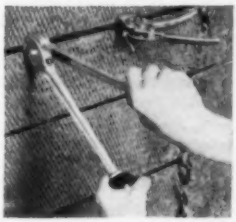
2 **Eagle-Picher authorized contractor-distributors are skilled thermal engineering specialists.**

They can help you control temperatures accurately and efficiently. They know how to help you solve difficult insulation problems.

3 **Eagle-Picher insulations are available where and when you need them.**

Fast delivery is assured by authorized distributors strategically located from coast to coast.

**A typical team of hard-working materials*



Eagle-Picher Mineral Wool Blankets —The answer to the problem of efficiently insulating flat or curved surfaces on larger types of heated equipment. Mineral wool is felted and secured with flexible metal fabric. Outstanding physical and chemical stability for maximum resistance to water, steam, corrosive fumes and normal vibration.

Eagle-Picher Super "66" Insulating Cement — An all-purpose, rust-inhibitive, extra-adhesive insulating cement. Provides great coverage... retains thermal efficiency. Dry coverage, 50-55 sq. ft. 1 inch thick per 100 lbs. Efficient up to 1800 F. Reclaimable where temperatures do not exceed 1200 F. Easily applied on all kinds of surfaces.

Eagle-Picher Insulseal—Protects insulation with a tough, weatherproof coating. For temperatures up to 450 F. Smooth troweling qualities assure uniform coverage, proper thickness. Protects against air infiltration, fumes, rain, snow and vibration... withstands severe all-weather service. Dries to a smooth rich black. Washable.

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Since 1843 • General offices: Cincinnati (1), Ohio

Insulation products of efficient mineral wool—for a full range of high and low temperatures. Technical data on request.

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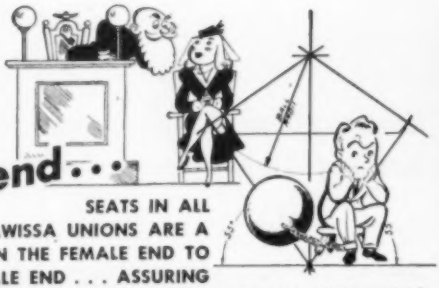

SEATS IN ALL CATAWISSA UNIONS ARE A 55° ANGLE ON THE FEMALE END TO A BALL ON THE MALE END . . . ASSURING A PERFECT SEAL EVEN 'THOUGH THE PIPE IS NOT IN ALIGNMENT!

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a type for every use . . . all temperatures, all pressures!

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Order PYREX Brand Sight Glasses from your Mill Supply Distributor. He also stocks PYREX and CORNING Brand Tubular Gauge Glasses, MACBETH Brand Flat Gauge Glasses, PYREX Brand Oil Cup and Lubricator Glasses.

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BOOKS of Current Interest

Piping, Pressure Vessels

Simplified Piping and Pressure Vessel Design, Dr. Alois Cibulka, Gulf Publishing Company, P. O. Box 2608, Houston 1, Texas. $3.

The charts and tables used in private design practice by the author during his 20 years as chief design engineer and chief draftsman for a large oil refinery are made available for the first time in this book. Complicated mathematical formulas are simplified so that it takes only a few minutes to solve piping expansion problems requiring a much longer time if solved by customary methods. Flanges, valves, fittings, drillings, series and essential information needed by piping draftsmen, plus information on lead pipes, transite pipes, copper tubing, equivalent flow capacities is presented in a convenient, easy to use manner. A table on page 25 shows over 50 items related to any size of steel pipe from ⅛- to 16-inches in diameter inclusive. Pressure and vacuum vessel calculations are reduced to seconds without the use of a slide rule. Another chart gives stresses in conical bottoms of vessels, which, the author claims, will do away with the Boiler codes' requirement of actual tests on vessels with eccentrically constructed conical bottoms in absence of acceptable mathematical proof.

Russian Journal Translation

Cross Index of the Journal of General Chemistry of the USSR (Vol. 20, 1950), English translation, Consultants Bureau, 152 West 42nd Street, New York 18, N. Y. $5.

A comprehensive cross index to the English translation of the Journal of General Chemistry of the USSR, which contains four sections: 1) titles of papers, listed in sequence of appearance in the journal; 2) author index, arranged alphabetically; 3) subject, arranged alphabetically; and 4) index to organic compounds, arranged according to empirical formula. The latter classification contains more than 1600 entries. Reference to the pagination of the English translation is given throughout the cross index. The original Russian pagination is also provided in the section listing titles of the 349 papers which appear in the 1950 volume. Any paper listed in the index may be secured in English translation from the publisher for $5.

Punched Card Systems

Punched Cards, Edited by Robert S. Casey and James W. Perry, Reinhold Publishing Corporation, 330 W. 42nd Street, New York 18, $10.

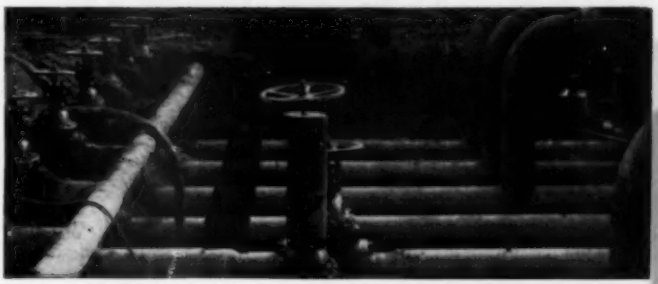
The first comprehensive summary of mechanical devices (and punched cards in particular) for scientific information problems is presented in this volume. The book describes in detail how to store and codify for immediate reference the vast literature of science through the use of punched cards. The treatment is completely realistic. Mechanical handling and operation of card systems of all sizes receives special emphasis. The volume outlines principles which can be applied to larger and larger files and describes all makes of equipment and cards currently available. It is the only book covering both hand and machine-sorted punched cards. It is also the only one which serves as an elementary instruction manual. The authors succeed in tieing the many diverse uses of punched cards together in terms of basic operations and fundamental theory.

Chemical Processes

Modern Chemical Processes, Volume II, edited by *Industrial and Engineering Chemistry* staff, Reinhold Publishing Corporation, 330 W. 42nd Street, New York, $5.

This is the second volume in a series documenting American chemical technology. Volume II contains the same factually authoritative pattern laid down by its predecessor. Twenty-four recently developed chemical processes, all now in operation on a full scale production level, are described in the light of the following essential details:

Background, including commercial and technical history and the origin of present installation; description of plant installation, including design details of non-standard items; description of process and operation of plant; economies of process, including raw materials and processing cost breakdowns, plant investment and amortization; personnel; and future prospects, including technological improvements of the process and changes in the industrial picture.



HOW IS YOUR EMERGENCY STOCK OF WELD+ENDS?

When an important pipeline goes down for emergency repair it costs several thousands of dollars just for interrupted service. At times like that you wish you had a dozen extra welders. It's then that WELD+ENDS really pay for themselves.

FOR NATURAL GAS, CRUDE OIL AND PRODUCTS PIPELINES USE WELD+ENDS, SAVE SHUTDOWN TIME

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- SAVE WELDER'S TIME
- SAVE SHUTDOWN TIME

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About EQUIPMENT and SERVICE Suppliers

TECHNICAL CONFERENCES—Two of the largest privately sponsored technical meetings ever held in the Gulf Coast Area were conducted jointly by the Metal Goods Corporation and the International Nickel Company in Houston recently. The conferences were held concurrently and featured discussions on the applications of nickel in the chemical and petroleum industries. The meeting was attended by 110 representatives from major chemical companies. Speakers at the conference pointed out that today there are more than 3000 alloys in which nickel is an important constituent. Because of the outstanding characteristics of its alloys, especially in resisting corrosion and high temperatures, more and more nickel has been directed to special fields in the past few years. Sponsors of the joint chemical and petroleum conferences are shown herewith. In the usual order, front row, they are: R. J. Gallagher, Metal Goods Corporation; J. F. Mason, Inco; C. J. Bianowics, Inco; R. E. Grote, Jr., Metal Goods Corporation; Dr. W. A. Mudge, Inco. Rear: Dr. E. N. Skinner, Inco; B. B. Morton, Inco; and H. T. Gregg, Metal Goods Corporation.

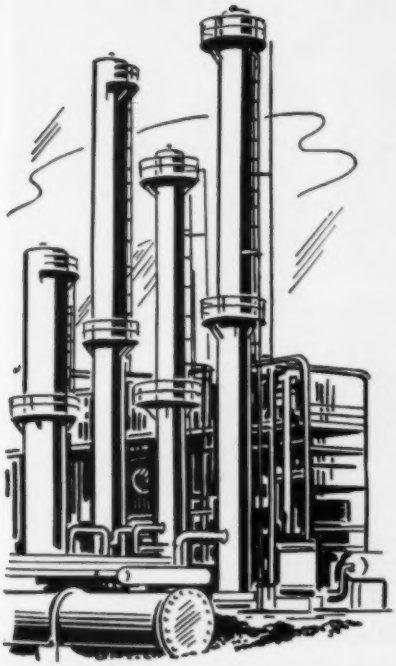
Schlueter, Refinery Supply President, Presented Medal

At the NGAA meeting in Houston recently, W. A. Schlueter, president of Refinery Supply Company of Tulsa, and vice president of Central Scientific Company, was presented with a medal for helpful instrument service in the natural gasoline industry. Schlueter's contribution to the standardization of testing methods in the petroleum industry goes back over 40 years, during which he helped develop several instruments important in the testing of materials. He is a member of the American Petroleum Institute, American Society of Testing Materials and the Scientific Apparatus Makers Association of America, and a director of the International Petroleum Exposition.

Leeds & Northrup Purchases 125-Acre Pennsylvania Tract

The purchase of a 125-acre tract of land at North Wales, Pa., in the Philadelphia suburban area, has been announced by Leeds & Northrup Com-

A "NATURAL" for GASOLINE PLANTS



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Ingersoll-Rand Turbo-Blowers

✓ LOW IN POWER COSTS
✓ LOW IN MAINTENANCE
✓ HIGH IN AVAILABILITY

In Natural Gasoline Plants, Catalytic Cracking units, and wherever large volumes of air or gas must be compressed to moderate pressures, over 3,000,000 horsepower of Ingersoll-Rand Turbo-Blowers are repeatedly proving their economy and dependability.

They save on *power costs* – through higher sustained efficiency, year after year. They save on *maintenance* – because they require less of it, even under the most severe operating conditions. And their high *availability* avoids costly shut-downs – keeps them earning money by maintaining maximum production.

Whatever your blower application, Ingersoll-Rand can design and supply the Turbo-Blower that's right for the job—a blower you can depend on for constant delivery of air or gas at the lowest cost. Sizes: to 21,000 hp, to 110 psig and higher, to 155,000 cfm.

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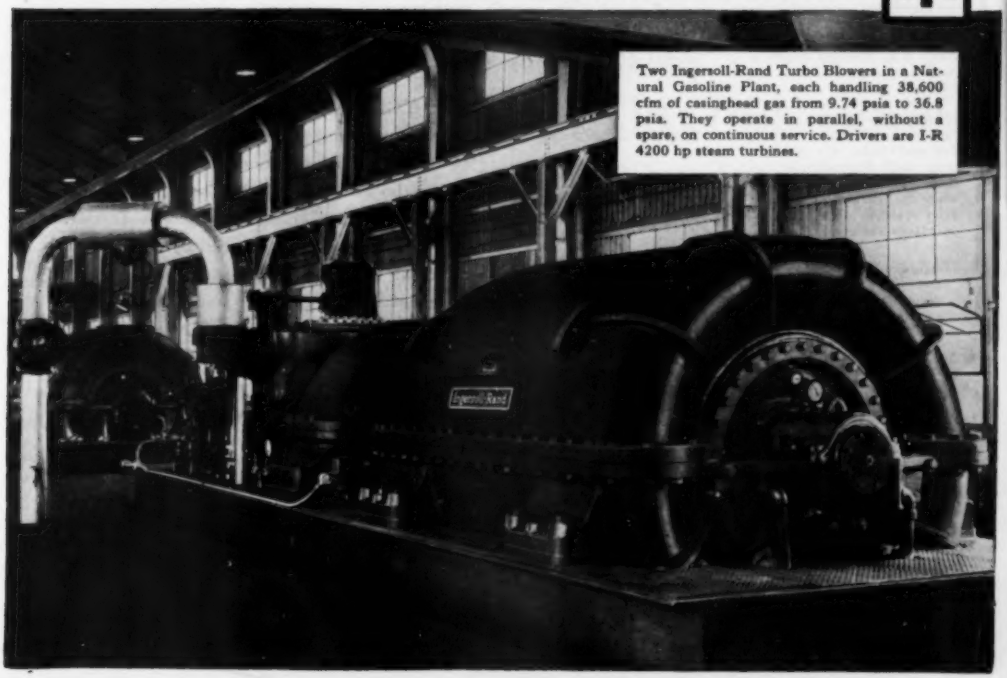
COMPRESSORS • AIR TOOLS • ROCK DRILLS • TURBO-BLOWERS
CONDENSERS • CENTRIFUGAL PUMPS • DIESEL & GAS ENGINES



Two Ingersoll-Rand Turbo Blowers in a Natural Gasoline Plant, each handling 38,600 cfm of casinghead gas from 9.74 psia to 36.8 psia. They operate in parallel, without a spare, on continuous service. Drivers are I-R 4200 hp steam turbines.

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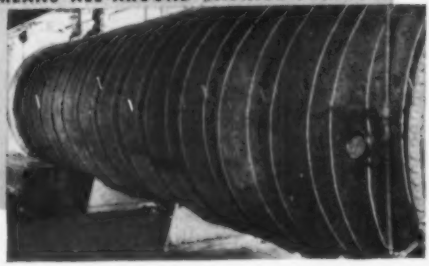
how **Keeping Heat** in a **Vulcanizer**

MEANS ALL-AROUND SAVINGS FOR YOU



1. Wrap B-H metal-reinforced Black Rockwool Blankets around the vulcanizer's external surface—butt blanket edges carefully to secure a blending interlock. B-H Blankets are excellent insulation for any curved or irregular surface and give protection up to 1200°F.

Saves overlapping waste

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Baldwin-Hill insulations are designed for more than effective, efficient heat saving . . . they're also designed to save you time and money . . . Therm-enomically. Send for complete information today.

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☐ POWERHOUSE CEMENT (High-adhesion, Black Rockwool Insulating-Finishing Cement)

☐ MONO-BLOCK (Porous, felted, Black Rockwool Insulation Block)

☐ NO. 1 CEMENT (Plastic, rust-inhibiting, Black Rockwool Insulating Cement)

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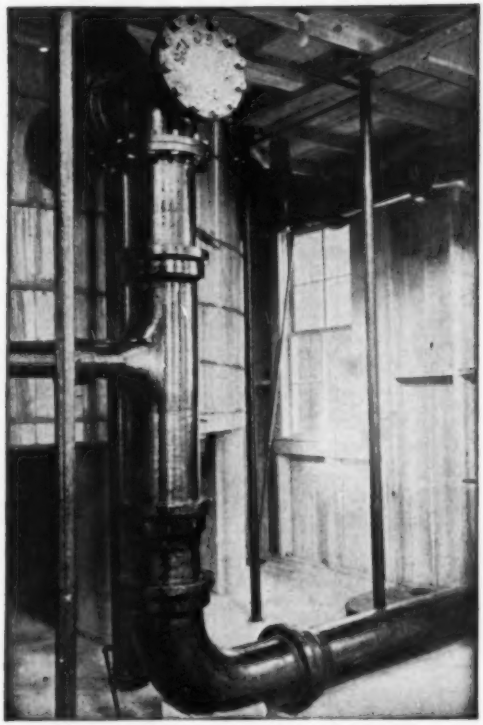

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A relatively low first-cost material, cast iron pipe is usually cheapest in the end, for many refinery applications, because of its stubborn resistance to corrosion. Available with bell-and-spigot, plain end and flanged, or with standardized mechanical joints.

Cast Iron Pipe Research Association, Thomas F. Wolfe, Engineer, 1015 Peoples Gas Bldg., Chicago 3, Illinois.

CAST IRON PIPE

FOR LONG LIFE AND ECONOMY

pany. Although ultimate use of the tract remains to be determined by engineering surveys, the company contemplates moving to the new locations certain operational or laboratory units from its main plant in Philadelphia.

American Meter Company Names Two New Sales Appointments

Bertram S. Truett has been recently appointed district sales manager in San

Wynne

Truett

Francisco, and Edward L. Wynne has been appointed sales representative in the Chicago sales territory of American Meter Company. Truett has been with American Meter since 1937. He was a sales engineer in the San Francisco division until 1942 when he went on active duty with the Navy. After the war, he returned to the San Francisco office. Wynne has been with the company since May of 1951. For the past year he has been undergoing a period of factory training for familiarization with the company's complete line of meters. Prior to his association with American Meter, he served in the U. S. Army Air Forces and was associated with the Minnesota Mining and Manufacturing Company.

A. O. Smith Makes Will Cain New Orleans Representative

Will Cain has been appointed New Orleans sales representative for the A. O. Smith Corporation, steel fabricators and process equipment manufacturers. Cain, a 1948 graduate of the University of Texas, previously a sales engineer on A. O. Smith's Houston staff. He will handle process equipment, line pipe casing, industrial grating and vertical turbine pumps. Process equipment made by A. O. Smith is in use in several industrial communities of the Mid-South, including refineries at Baton Rouge and Norco.

Will Cain

Franklin Shareholders Vote Construction of Warehouse

At their annual meeting, the shareholders of the Franklin Supply Company approved the directors decision for the establishment of a new warehouse at Casper, Wyo. Dan Nye, formerly at Oklahoma City, Okla., has been transferred as store manager at Casper. Robert Brewster has been appointed district manager at Oklahoma City. Jene Harper, president, advised the share-

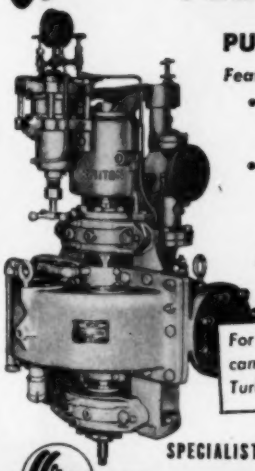
Whiton

SOLID STEEL ROTOR

VERTICAL TURBINES

Economical—Dependable . . . for

PUMPS • FANS • COMPRESSORS



Featuring:—

- SOLID STEEL ROTOR . . . gives high efficiency for low-speed, direct drive.
- LABYRINTH SHAFT SEAL . . . positively prevents leakage. Eliminates wear and seizing.

Available in various types and frame sizes up to 600 Horsepower.

For full information on how Whiton Turbines can fill your requirements, write directly to our Turbine Division.

SPECIALISTS IN HORIZONTAL AND VERTICAL TURBINES.

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NEW LONDON 14, CONN., U.S.A.

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REFINERY ERECTION CRANES

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4—3000-B Manitowoc 50-ton Cranes, 120 ft. jib

1—3500 Manitowoc 60-ton Crane, 120 ft. Jib

2—3900 Manitowoc 65-ton Cranes, 130 ft. Jib

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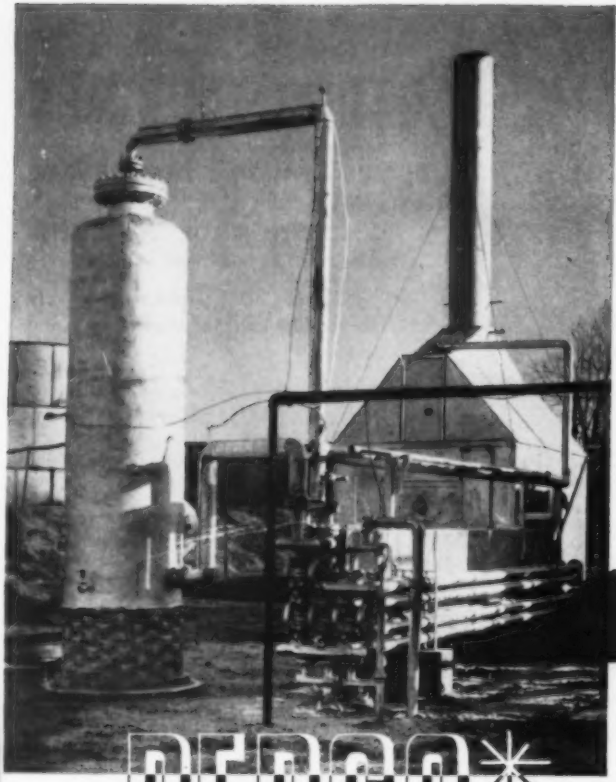


PERCO*

CYCLOVERSION* AT SOMERSET, KENTUCKY

Somerset Refinery now operates this 400 barrel per day Cycloversion unit to desulfurize straight run gasoline. The upgraded product helps Somerset materially in meeting current marketing specifications.

This small, simple unit was constructed on site. Two regular plant employees erected the unit with minimum expense in less than five weeks. No shutdown time was required in the rest of the refinery.

How about letting Perco Processes help you? Write us for additional information.

Perco Division PHILLIPS PETROLEUM COMPANY Bartlesville, Oklahoma

*A Service Mark

holders that in accordance with their decision reached during the last meeting, the Franklin Pipe & Supply, Ltd., had been formed and authorized to do business in Canada. Company headquarters will be situated at Edmonton, Alberta, Canada.

J. M. Dumser, J. P. Howland Named In Wolverine Tube Promotions

The appointments of J. M. Dumser as director of sales and John P. How-

Dumser

Howland

land as sales representative in the Dallas, Texas, area have been announced by the Wolverine Tube Division of Calumet and Hecla Consolidated Copper Company. Coming to Wolverine in 1951, Dumser has held the position of general sales manager. Dumser replaces George D. Potter who has resigned to devote his full time to the operation and sales program of the Corey Steel Company of which he is a vice president.

Howland, the new Dallas area sales representative, was formerly in various sales capacities at Wolverine Decatur Mill prior to his present assignment. He will have his headquarters in Dallas.

Beckman Instruments Forms Special Products Division

Beckman Instruments, Inc., has recently established a new special products division under the direction of J. F. Bishop which will be devoted primarily to the study and development of special instruments brought to it by industrial organizations. The newly-established division is a separate organization within the Beckman Instruments operations and is located in its own plant. Special instruments already in production by this division include a phase equilibrium computer, an automatic titrator for moisture determination, and electrophoresis convection apparatus an analog computer and other special purpose instruments.

Bishop

Brown Succeeds Ankeny In Hardinge Central District

Clarence Blair Brown, Jr., will direct the activities of the central district office of the Hardinge Company, Inc., filling the vacancy created by the relocation of Clement W. Ankeny to Phoenix, Ariz. Brown is a mechanical engineering graduate of Virginia Polytechnic Institute. After graduation he served with the Glen L. Martin Aircraft Company before

NOW, AS ALWAYS

PABCO PRECISION MOLDED

85% MAGNESIA HEAT INSULATION

PABCO PRECISION MOLDED INSULATIONS

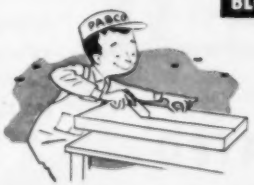
APPROVED ENGINEERING SERVICE UNIT

MODERN ENGINEERING demands precise standards of heat insulation performance. Pabco's *Precision Molded* 85% Magnesia combines the time-tested superiority of Magnesia with precision molding to give you a light weight insulation manufactured to very close tolerances.

EASIER TO CUT

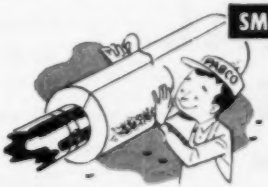
Pabco *Precision Molded* 85% Magnesia cuts easily and cleanly. That's because Pabco's manufacturing methods give you "ductile" strength and firmness unprecedented in the field of heat insulation materials.

BLOCKS SCORE CLEANLY



Pabco *Precision Molded* 85% Magnesia Blocks score quickly and cleanly. So important when splitting, or when preparing "hinges" for application to large rounded surfaces.

SMOOTH RIND SURFACE



Because Pabco *Precision Molded* 85% Magnesia is molded to exact final size and thickness, its surfaces are smoother with a finished "rind." Easy embedding of tie wires, a stronger surface . . . and a faster, easier clean-up!

THE DEPENDABLE STANDARD — "MODERNIZED"

quality

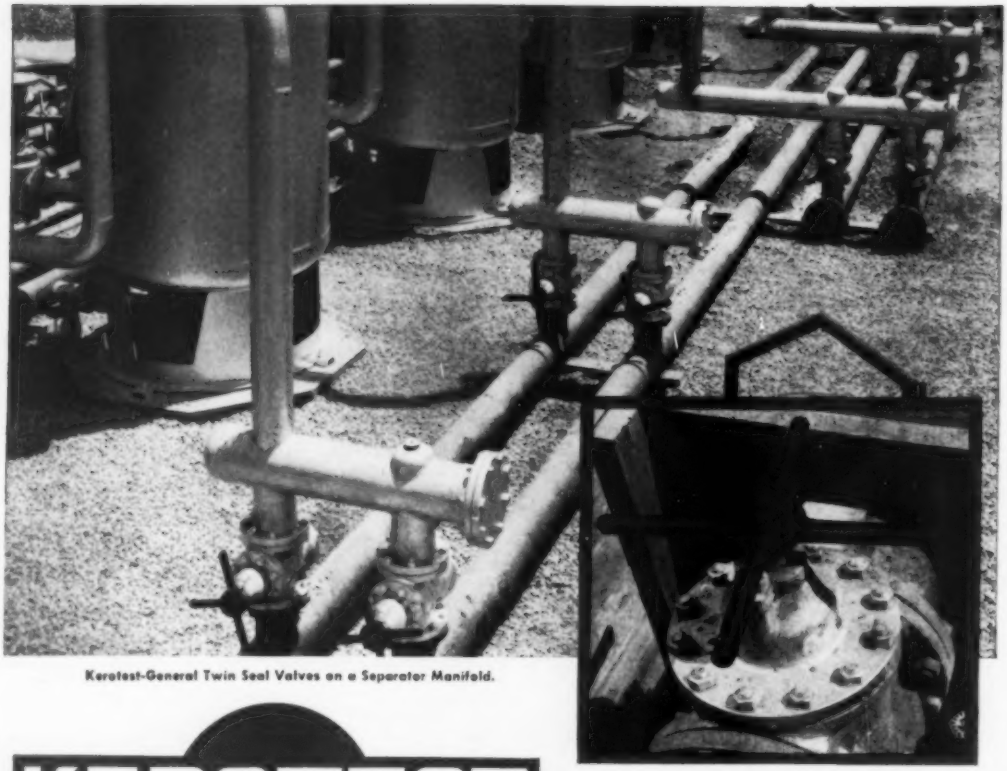
PABCO PRODUCTS INC.

INSULATION DIVISION

San Francisco 19 New York 16

Manufacturers of Heat Insulation Since 1920

PABCO ENGINEERING SERVICE UNITS IN ALL PRINCIPAL CITIES



Kerotest-General Twin Seal Valves on a Separator Manifold.

KEROTEST
GENERAL

NON-LUBRICATED TWIN SEAL VALVES

- ✓ Shuts off Vapor-Tight
- ✓ Easy to Operate
- ✓ No Lubrication
- ✓ Quick Operation
- ✓ No Scoring or Galling

TYPICAL USES

PROPANE	NATURAL GAS
BUTANE	LIGHT HYDROCARBONS
GASOLINE	LIQUID NITROGEN
LIQUID OXYGEN	CARBON DIOXIDE
CRUDE OIL	COMPRESSED AIR

The Kerotest-General Twin Seal Valve is recommended for gas and liquid service in a pressure range up to 5000 psi at 200° F. Seats shut off vapor-tight—no galling or scoring. Operates *without lubrication.* Special trims are supplied for corrosive service.

WRITE for descriptive bulletin giving full specifications.

KEROTEST MANUFACTURING COMPANY

going into the Navy as an aviation ordnance expert. In 1946 he joined the Hardinge organization as an engineer and, until his recent appointment, had been engaged in field service, estimating, development, design and sales engineering.

Oliver Filters Names Oliver Executive Vice President

The Board of Directors of Oliver United Filters, Inc., has announced the appointment of E. L. Oliver, Jr., as executive vice president, a change from his recently appointed position of vice president-manager. As executive vice president, he will retain the duties of manager but will have broader administration responsibilities. In his 19 years of association with the company, Oliver has served in many capacities. He is well-known to the customers of Oliver United, having spent several years in sales and field engineering.

Oliver

Metallizing Division Set Up In St. Louis By Nooter Firm

The Nooter Corporation has announced the establishment of the St. Louis Metallizing Company, formerly the Metallizing Division of the Nooter Corporation. The newly-formed company will retain the same personnel, equipment and management. In addition to metallizing work, the new company will offer two other industrial services: hard surfacing and plastic coating. The management of the new company will still include Walter B. Meyer, president; Joseph A. Peressin, vice president; Raymond Craven, vice president; and Elmer Smitt, secretary-treasurer.

Meyer

Eastern Division of Midwest Piping Moves to New Quarters

E. A. Kerbey, executive vice president of Midwest Piping & Supply Company, Inc., has announced the transfer of their eastern division offices to 50 Church Street, New York, in March. The move provides approximately twice as much space as occupied formerly, and was made to meet the needs of the growing business, company officials said.

Welsh, Worthington Veteran, Receives 25-Year Service Award

Alvin F. Welsh, veteran of 25 years service with Worthington Pump and Machinery Corporation, Harrison, N.J., received a sapphire-studded service pin in an informal ceremony in the reciprocating pump sales department, of which Welsh is manager. After attending St. Mary's College, St. Mary's, Kans., Welsh started as an estimator at Worthington's

Announcing a New

INTERNATIONAL

headline achievement–a truly sensational step in the science of Chemical Mixing–a new and important concept in the field of Fluid Agitation . . .

The INTERNATIONAL STABILIZER-BAFFLE stems from International's pioneering research in the Science of Mixing as a basic Chemical Engineering Unit Operation. • It prevents ineffective mass rotation and creation of a liquid vortex. • It induces top-to-bottom turnover instead of non-useful horizontal swirl. • It is an anti-settling and anti-layering device, improving the flow pattern produced by helical propeller type mixing elements.

The INTERNATIONAL STABILIZER-BAFFLE eliminates the whipping of free-end suspended vertical mixer shafts, with no appreciable side thrust exerted on the shaft. It prevents shaft failures which would otherwise occur from critical speed considerations. It makes possible the use of long thin shafts, up to 10 ft. in length, without the use of steady bearings or step bearings. It eliminates the need for submerged bearings with their attendant maintenance and repair problems. Consumes little space and need not rest on the bottom of tank. Thus, there is not the usual "dead" volume as with ordinary tank baffles. It can be readily removed for cleaning purposes, if necessary. Informative Literature sent on request.

The International
STABILIZER BAFFLE
ELIMINATES MIXER SHAFT WHIP—AND LIQUID VORTEX

These two photographs illustrate the startling difference in flow pattern, occuring with and without the INTERNATIONAL STABILIZER BAFFLE, under exactly the same conditions. The shaft speed, propeller and rheological properties of the mix being the same in both cases . . . Impeller is center-mounted operating Counter-clockwise at 1750 RPM. Turnover and overall Agitation in above photograph is effected by splitting of helical stream, causing the flow to follow a radial path to the tank wall, and thence upward.

INTERNATIONAL MIXERS are now being used throughout the world for all industrial applications. They are available in all metals and coatings and for all power sources or current characteristics.

Above photograph shows the deep vortex and poor solids distribution, without the INTERNATIONAL STABILIZER BAFFLE. Note that there is little top to bottom turnover and inefficient flow pattern.

INTERNATIONAL sales engineers are available in your area to help you with your mixing problems. These sales engineers are right behind the International performance and workmanship guarantee.

Send for Catalog—

- ☐ TECHNICAL SUPPLEMENT No. 111 ON STABILIZER-BAFFLE
- ☐ CATALOG 76 ON PORTABLE MIXERS
- ☐ CATALOGS 72 & 76 ON TOP AND SIDE ENTERING AGITATORS
- ☐ CATALOG 130 ON CHEMICAL PROCESSING EQUIPMENT

INTERNATIONAL ENGINEERING, INC.

NEW YORK
15 PARK ROW
WORTH 2-2580

DAYTON 1, OHIO

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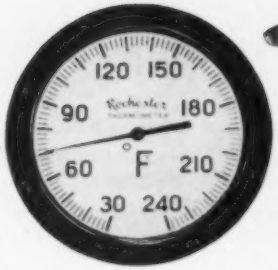
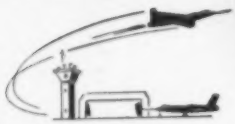
WABASH 2-0733

Smooth action...





STAINLESS-STEEL CONSTRUCTION —welded— more durable, sensitive, pressure tight, corrosion resistant.

Rochester DIAL THERMOMETERS
react instantly to temperature changes!

• The superior dampening in ROCHESTER Dial Thermometers will never *"set-up"* or *"freeze"* the pointer in one position. It assures fast, smooth action at all times. New bimetallic elements never *"tire"* or lose their accuracy . . . take violent temperature change without error in indication.

Made of *corrosion resistant* stainless steel . . . backed by 35 years of instrument-making experience . . . ROCHESTER Dial Thermometers are ideal for heavy-duty service. *And they're made to meet U. S. Air Force specifications.*

Order them today from your Rochester Representative or write for further details. Rochester Manufacturing Co., Inc., 38 Rockwood St., Rochester 10, N. Y.

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38 Rockwood St., Rochester 10, N. Y.
DIAL THERMOMETERS GAUGES AMMETERS

EXCEL-SO
Combination
SEPARATOR-FILTER-AIR ELIMINATOR
FOR REMOVAL OF BULK QUANTITIES OF WATER, SCALE, ROUGE AND AIR-

SEND FOR DESCRIPTIVE BULLETIN FEQ-51

..from Refinery or Gasoline Plant Process Streams, Pipe Lines, Tank Car Loading, Marine Refueling, Truck Loading Racks, Airport Refueling Trucks, and Airport Refueling Systems.

Wherever gasoline or light oils may be contaminated by water, scale, muck, or air—EXCEL-SO can be depended upon to deliver clean, dry fuel.

WARNER LEWIS COMPANY
BOX 3096 • TULSA, OKLAHOMA

Tulsa office in 1925, became an estimator in the Los Angeles office and then moved to the Kansas City office, becoming a sales engineer there in 1937. In 1942 he was transferred to the Reciprocating Pump Division in Harrison, N.J., of which he was made manager in 1948. Welsh makes his home at 41 East Reid Place, Verona, N.J.

Oil Well Supply Division Promotes Melvin F. Jones

The promotion of Melvin F. Jones to manager of the Gulf Coast area of U. S. Steel's Oil Well Supply division has been announced. Jones, who will be located in Houston, has served as manager of the sales staff at the Dallas, Texas, offices since 1948. He succeeds F. D. Smith, manager of the Gulf Coast area for the past four years, who has been transferred to Dallas as assistant to the general manager of sales. Jones is a veteran of 23 years with the Oilwell Supply division, his first positions being with the accounting department at Pittsburgh, Pa., and Oil City, Pa. In 1935 he was transferred to the accounting department at the Dallas headquarters and in 1939 he moved to Los Angeles as auditor for the California area. In 1949, he was promoted to assistant treasurer and returned to Dallas, holding this position until his promotion.

Jones

Harnischfeger Announces Two Personnel Promotions

The Harnischfeger Corporation has announced the recent personnel promotions of M. O. Monsler and W. R. Stephens. Filling a newly created post, Monsler is now manager of Harnischfeger's welder and electrode division after having been sales manager of this division for two years. Stephens is taking over the duties of sales manager of the welder and electrode division. Before his association with the company in 1947, Stephens served 11 years as a research laboratory metallurgist and electrode sales engineer. He joined Harnischfeger as a welder sales engineer in the Detroit office and has worked in that capacity until his recent promotion.

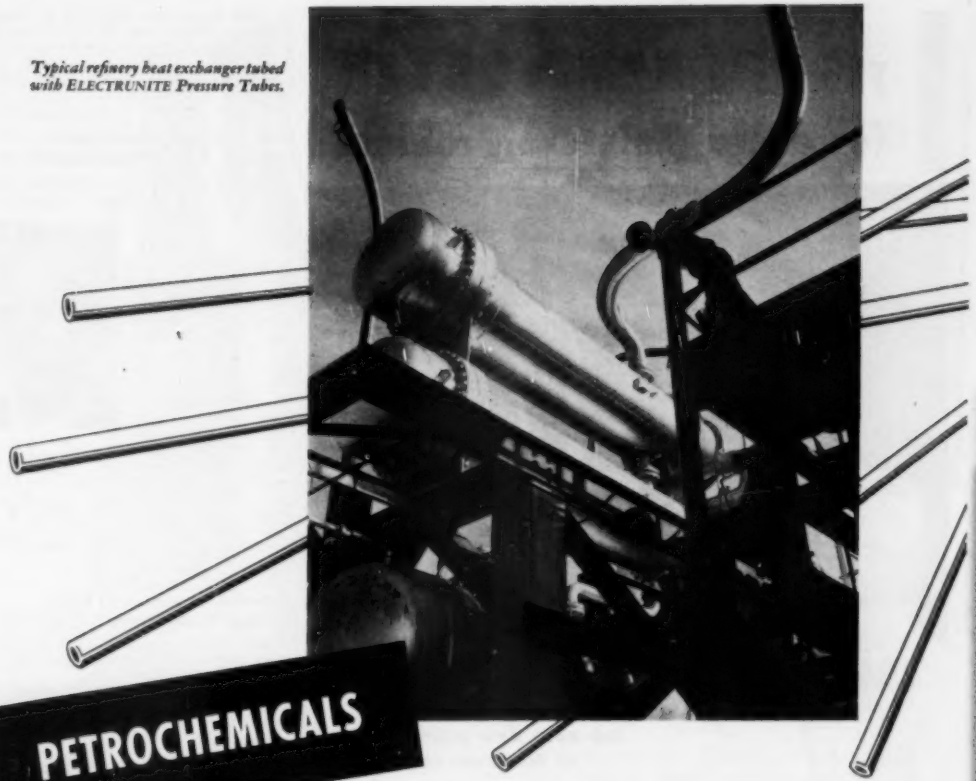
New Sales Engineer Added To Taylor Instrument Staff

A new industrial sales engineer, Edward M. Davis, has been added to the sales staff of Taylor Instrument Companies to serve in portions of the Tulsa territory. Davis received his degree in chemical engineering from Texas A&M after a two-year interruption spent in the U. S. Navy. He joined the Taylor concern in 1951 and was trained for his present position both at the company's home office in Rochester, New York, and at the Tulsa branch.

Clark Bros. Forms Latin Firm

Clark Bros. Pan American, Inc., was formed recently to act as the export corporation for Clark Bros. Company, Inc., Olean, N. Y. In addition to sales activity the new corporation will handle all serv-

Typical refinery heat exchanger tubed with ELECTRUNITE Pressure Tubes.



PETROCHEMICALS

...another industry that stays on-stream

with REPUBLIC ELECTRUNITE PRESSURE TUBES

Run through a list of the scores of different petrochemicals . . . count off the leading producers . . . you'll have lists that include hundreds of large installations and important users of Republic ELECTRUNITE Heat Exchanger, Condenser and Boiler Tubes.

The ELECTRUNITE process assures users that Republic's Pressure Tubes are top-quality inside and out . . . that tubes are uniform in wall thickness, roundness, and ductility. They are uniformly corrosion-resistant throughout the metal and full normalizing assures easier rolling-in properties in every length.

Let us tell you more about these pressure tubes that bend right, roll-in tight, stand up better wherever carbon or stainless steel tubes are specified.

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50th ANNIVERSARY 1902 1952 STEEL and TUBES DIVISION
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There's a KEMP DRYER for every Moisture Problem

Dry air, gases, liquids to sub-zero dew points . . . at minimum cost

Quality, diversity, flexibility, economy . . . four good reasons why Kemp Dynamic Dryers offer you the *best* solution for *any* moisture problem. Kemp superiority of design and engineering know-how is your assurance of *dependable, low-cost* performance whether you dry air, gases or liquids. Many Kemp users report drying to sub-zero dew points for as little as ¼¢ per mcf—including all charges for labor, capital investment and materials. In addition, Kemp guarantees operation of every unit to meet your specifications.

Kemp Engineering Versatile

Gas, electric or steam regeneration is standard equipment with every Kemp Dynamic Dryer . . . with or without cooling units. Also, depending on your needs, you have a choice of manual, semi-automatic or fully automatic operation. In every instance, Kemp will specify the proper dessiccant suitable for your operation. Chances are there is a standard Kemp design that is ideal for your plant and saves you money too. It costs you nothing to investigate.

3 BASIC DESIGNS AVAILABLE*

ORIAD—Dries air used to actuate tools, valves, instruments, etc., where drying requirements are moderate.

RADIATION COOLED—For small or medium flow rates. Offer low operating cost with maximum efficiency.

CONVECTION COOLED—Provide continuous drying capacity of air and gases at minimum cost.

*All of above in complete range of sizes with manual, semi-automatic or fully automatic operation.

KEMP OF BALTIMORE

DYNAMIC DRYERS

For technical information and facts on how Kemp Dryers can solve your moisture problems, write for Bulletin D-27 to:

THE C. M. KEMP MFG. CO.
405 E. Oliver St., Baltimore 2, Md.

ice and warehouse facilities in South America. Offices will be maintained in Mexico City, Caracas, Venezuela; Buenos Aires, Argentina; Bogota, Colombia; Lima, Peru, and Rio de Janeiro, Brazil.

W. R. Daugherty Named Sales Manager of The OTM Company

William Robert Daugherty has been appointed sales manager of The OTM Company, formerly known as O-T-M Supply Company. Daugherty is 44 years old and was born in Pittsburgh, Pa. He received a B.A. degree from Lafayette College in 1928, a law degree from Southwestern University in 1930 and an engineering degree from Carnegie Institute of Technology in 1933. Before joining OTM, he was employed by the Fish Construction Company. He had previously served with Indian Motorcycle Company, R. S. Evans and Associates, the American Bantam Car Company and Ballard Aircraft.

Daugherty

Dittenhoefer Appointed Kaylo Chicago Division Sales Engineer

Sam Q. Dittenhoefer has been named sales engineer in the Chicago office of the Kaylo Division of Owens-Illinois Glass Company. He will handle the sale of Kaylo heat insulation and insulating roof tile in the Chicago and Milwaukee areas. Dittenhoefer studied engineering at the University of Southern California and the University of California at Los Angeles. Before joining the Kaylor division, he was a sales engineer for the Fire Brick Supply Company of Minneapolis, Minn., and prior to that was sales promotion manager for new products of Do-All Incorporated.

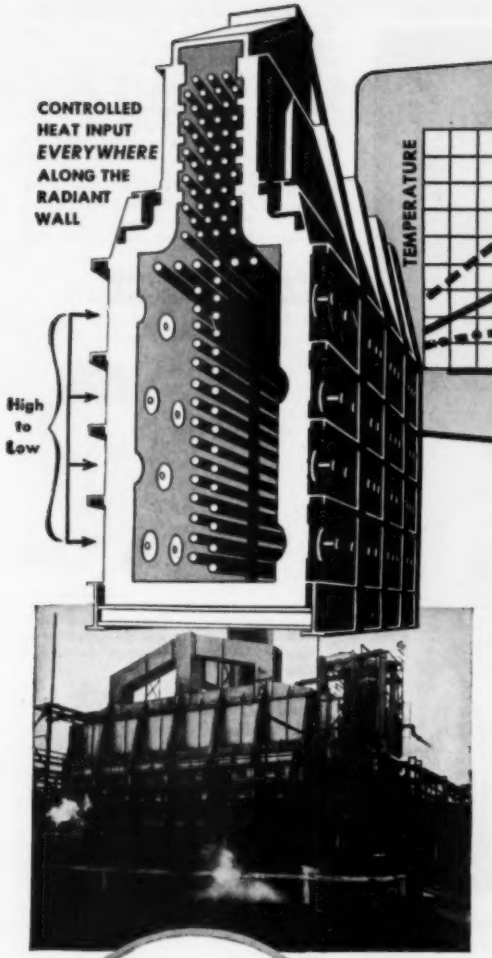
Dittenhoefer

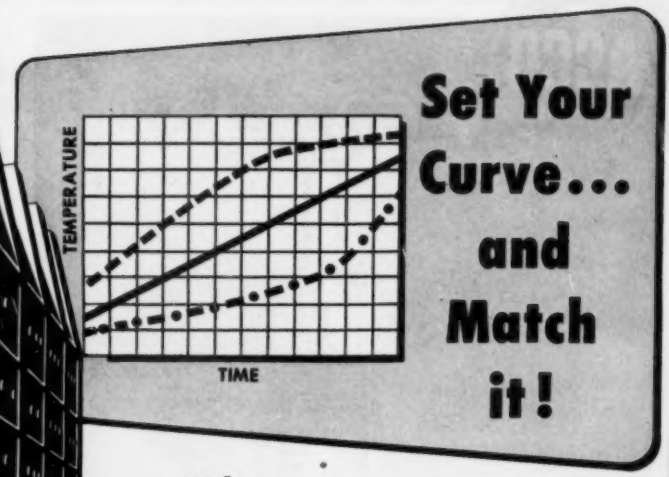
National Tube Appoints Bacon Specialties Division Sales Head

James P. Bacon has been appointed manager of sales, tubing specialties division, for National Tube Company, a U. S. Steel subsidiary. Bacon formerly was district representative in the tubing specialties division of the company in New York. He started with the National Tube Company in 1939 in the accounting department and moved into the sales field in 1943. In 1948 he was named office manager of the sales department at the Ellwood, Pa., Works.

Cooper, Tietz Named Inco Sales Department Managers

Ransom Cooper, Jr., has been appointed manager of the Nickel sales department and H. D. Tietz manager of the Inco Nickel Alloys department of The International Nickel Company, Inc.





Set Your Curve... and Match it!

with SELAS Gradiation HEATERS

(Above) Selas Gradiation Heater installed at Phillips Petroleum Refinery.

(Left) Convection type heater, with wide variation in heating rates, small radiant surface in a large tube surface requirement, probably tube overheating, large pressure drops.

Now, petroleum engineers determine the ideal time-temperature curve for specific refining processes . . . and match it in production with Selas Gradiation Heaters.

Selas Gradiation with precisely controlled, uniform radiant heat input makes possible:

- *Flexibility* in curve shaping
- *Precision controlled* residence time
- *Positive rate-control* of oil heating
- *Complete combustion* with little or no excess air

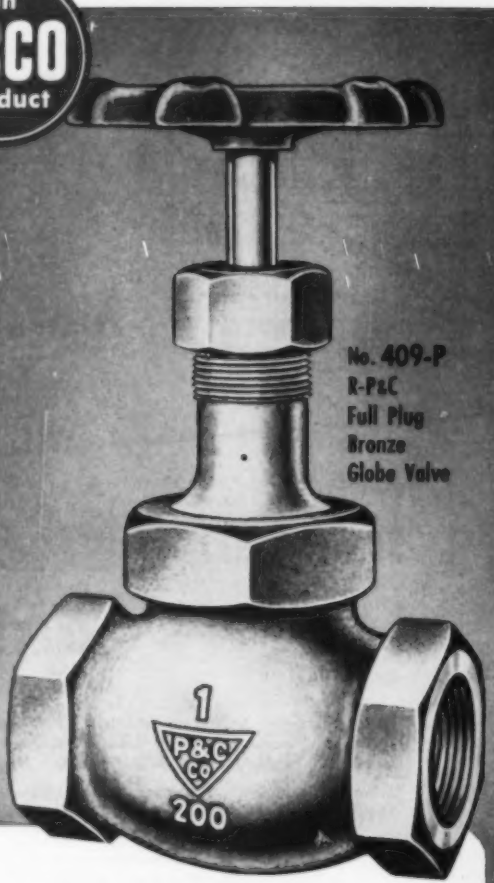
One refinery manager says: "This radiant heat source provides a high efficiency furnace that is easily installed . . . has low maintenance and fuel costs . . . gives smooth operation with high wind velocities . . . is capable of successfully processing a wide variety of charge stocks. This selective heat input to the radiant coils produces higher heat tranafer rates than the conventional heaters . . . saves initial tube costs, reduces residence time, allows high vapor velocities and low pressure drop."

Selas Gradiation Heaters offer new horizons in refining . . . whether small or large refinery, catalytic or thermal cracking. Let us send you more information. Write for new sixteen page booklet.

SELAS CORPORATION OF AMERICA
PHILADELPHIA 34, PENNSYLVANIA

Heat Processing Engineers for Industry • Development • Design • Manufacture

an ACCO product



• High test bronze body and bonnet; nickel-alloy disc and seat ring; high tensile, high torque rolled bronze stem—plus large, deep stuffing box easily repacked under pressure—these are the features which make R-P&C Bronze semi-plug and full-plug Globe and Angle Valves outwear ordinary valves. They're fine for frequent or continuous throttling of steam, gas, oil, water. This type valve can be furnished in 200, 300 and 350 lb. pressures.

See your R-P&C distributor for information on the complete line of R-P&C valves or write nearest district office.

ACCO

R-P&C VALVE DIVISION
AMERICAN CHAIN & CABLE

Reading, Pa., Atlanta, Baltimore, Boston, Chicago, Denver, Detroit, Houston, New York, Philadelphia, Pittsburgh, San Francisco, Bridgeport, Conn.

R-P&C valves

Cooper and Tietz will function under Walter C. Kerrigan and L. R. Larson, who as general sales manager and assistant general sales manager, respectively, are responsible for both primary nickel and mill products sales of the company. Cooper came to International Nickel in 1929 and has been assistant sales manager of the Nickel sales department for several years. Tietz joined Inco in 1931 as a salesman and in 1939 was appointed administrative assistant to the sales manager of the Inco Nickel Alloys department. He has been assistant to the manager of this department since 1941.

Crothers Appointed Manager Of General Controls Branch

George Crothers has been named manager of the new Toronto, Canada, branch office of General Controls Company. He joined General Controls in January of this year and previously held positions with Mall Tool, Ltd., Canadian Propellers, Ltd., and the Ford Motor Company. The new branch under Crothers supervision will elaborate the General Controls sales set-up in the Toronto area for handling sales, engineering and service on the company's line of automatic pressure, temperature, level and flow controls for domestic and industry use.

Crothers

Harold Krueger Appointed St. Louis Smelting Manager

Harold A. Krueger has been appointed manager of the St. Louis Smelting and Refining Division of National Lead Company. Krueger, who has been production manager of the division since 1950, began his company career in 1942 as an engineer. He became successively a mine foreman and general mine foreman, and in 1944 he was named assistant superintendent in charge of the Tri-State mines. He was appointed general superintendent of the Baxter Springs, Kan., operations in 1948 and plant manager of the Tri-State operations the following year.

Aluminum Company Appoints Stakel Advertising Manager

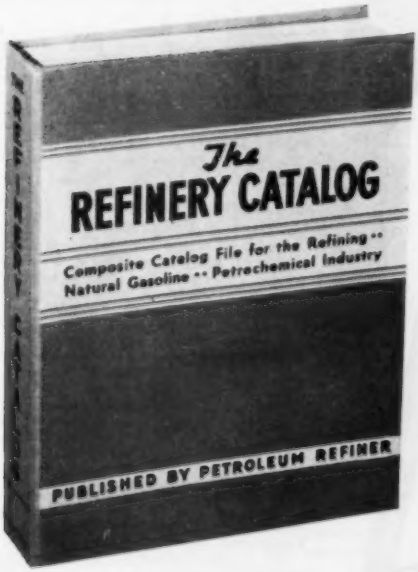
Frederick C. Stakel has been named advertising manager for Aluminum Company of America. Since 1947, Stakel has been manager of advertising and sales promotion for Brown Company of Berlin, New Hampshire. Previously he was New York district manager for the Scott Paper Company. Stakel is a graduate of Ohio State University and the New York University Graduate School of Business Administration. As a Naval officer in World War II, he saw service in various areas and attained the rank of Lieutenant Commander.

Airetool Company Announces Two New Sales Representatives

The Airetool Manufacturing Company has announced two new appointments in its sales organization. Paul B. Soderberg, formerly associated with Leo Fin-

Starting a New Project?

Refinery Catalog has complete data on equipment and services for the Refining Industry.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PAGE Welding Electrodes AND Rods

tel, manager of The Airetool Chicago sales office, has been named manager of the firm's New Jersey office, replacing E. K. Ingalls. James W. Kueker has been named to fill the post vacated by Soderberg in the Chicago sales office.

Allen Joins Wall Colmonoy As Eastern Seaboard Sales Head

Anthony J. Allen has joined the Wall Colmonoy Corporation as Eastern sales manager with headquarters in New York and will be in charge of sales on the Eastern Seaboard. A graduate of Boston University and Armour Institute of Technology, he has spent his time since graduation as sales engineer and sales manager in the metal working industry Wall Colmonoy states that Allen is thoroughly familiar with the hard facing industry, both in its technical and sales aspects.

Allen

Homestead Valve Appoints Two New Vice Presidents

Homestead Valve Manufacturing Company has appointed Don H. Krey, vice president in charge of sales, and John W. Force, vice president in charge of engineering. Both appointments are effective for all of the company's three divisions, which include the valve plant, the Hypressure Jenny steam cleaner plant, and the chemical compounding plant in Edgeworth, Pa.

Graduates of Carnegie Institute of Technology, both men have worked their way up through the company's organization; and have been a part of the executive group during Homestead Valve Manufacturing Company's greatest growth. Force made his start in the valve engineering department 26 years ago, while Krey joined the company in 1935.

G. V. Slottman Elected Vice President Of Air Reduction

Directors of the Air Reduction Company, Inc. have elected George V. Slottman as a vice president. He has been the company's director of research and engineering since February, 1949, and will continue in charge of that activity. A native New Yorker, Slottman was graduated from Massachusetts Institute of Technology in 1925. Two years later he received his Ph.D. from the University of Berlin. He joined Air Reduction Company in 1934 and since that time has served as manager of the general technical sales department, technical assistant to the vice president and director of research and engineering.

Babcock & Wilcox Process Equipment Manager Retires

The retirement of A. R. McAllister, manager of the Process Equipment Division of The Babcock & Wilcox Company has been announced by the company. With the company for 32 years, McAllister requested release from his duties because of poor health. Born and educated in Glasgow, Scotland, he came to this country and joined B&W in 1916. Soon after he went into the U. S. Army and served for almost two years during

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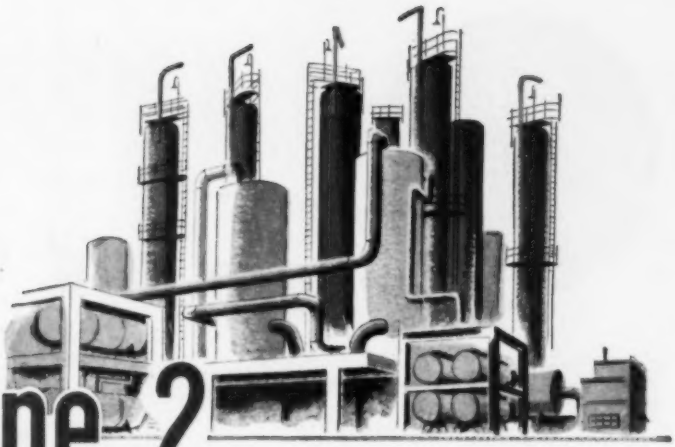

Tenamene 2

inhibitor-sweetening

Cuts costs—eliminates danger of contamination—saves time and equipment

Tenamene 2 inhibitor-sweetening involves the use of this efficient Eastman gasoline additive both as a sweetening agent and as a gum inhibitor, and thereby makes possible the combining of two operations in a single step.

Tenamene 2 appears to act as an oxidation catalyst with regard to mercaptans. Its presence in sour gasoline enables refiners to convert mercaptans to disulfides merely by adding 10-20° Baume caustic and bubbling air through such gasoline at slightly elevated temperatures.

The Tenamene 2 itself is not reacted upon and thus remains in the gasoline after the sweetening process to provide effective protection against the formation of gums.

WHEN TO USE: If you are depending upon a solutizer process and have trouble in economically obtaining "Doctor" sweet gasoline, we recommend that Tenamene 2 inhibitor-sweetening be investigated as an adjunct to your present process. When Tenamene 2 inhibitor-sweetening and solutizer sweetening are combined, a considerable reduction in heat costs and a saving in time and equipment can frequently be realized, due to the decrease in recycling necessary in the solutizer units. The small amount of disulfides remaining in the gasoline after this combination treatment does not seriously affect tetraethyl lead susceptibility.

Where oxidation processes such as Copper sweetening or Doctor sweetening are used, we recommend that Tenamene 2 inhibitor-sweetening be considered as a replacement. While this process is also one of oxidation, it not only eliminates the dangers of copper or free sulfur contamination, but also eliminates the costly regeneration of the treating agents.

HOW TO SWEETEN WITH TENAMENE 2: Sour gasoline is first freed of hydrogen sulfide, organic acids and the more reactive mercaptans by a conventional caustic wash. 4 to 26 pounds of Tenamene 2 per 1,000 bbls. of gasoline are then added along with approximately 10 volume percent of 10° to 20° Baume caustic and air or oxygen. The resulting mix is thoroughly agitated and piped to a settler. The effluent from the settler is handled in the same manner as the effluent from conventional sweetening units, except that no more inhibitor is required.

Whatever your present sweetening process, it will pay to investigate Tenamene 2 inhibitor-sweetening. The staff of our gasoline laboratories will be pleased to work with you in determining how this process can be most effectively used in your refinery. Contact your local representative or write to Tennessee Eastman Company, Division of Eastman Kodak Company, Kingsport, Tennessee.

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World War I. In 1919 he returned to the company at Barberton, Ohio, where he worked in the machine and drum shops and later in the estimating department. He also spent several years with the alloy foundry at the Beaver Falls, Pa., plant, becoming foreman of the foundry. In 1931 he joined the Process Equipment Division at the Barbeton works, and was made manager in 1932, remaining in this post until his retirement.

L. N. Burke Named Pipebending's Houston Sales Representative

The appointment of L. N. Burke as Houston sales representative has been announced by the Texas Pipebending Company. Burke is a native of Arizona, and a graduate of New Mexico Military Institute and the University of Arizona. He is a member of Phi Delta Theta. Following his graduation, he was associated with the Southern Pacific Company in Sacramento, Calif., for six years. For the past six and one-half years, he has been connected with The Lummis Company in New York. He is married and has two children.

Burke

Thompson Named Lunkenheimer Industrial Relations Director

The former associate director of industrial relations of Parke, Davis & Company, Leo F. Thompson, has been appointed industrial relations director of The Lunkenheimer Company. During World War II, he held the position of employe relations manager at the Wright Aeronautical Corporation plant at Lockland, Ohio. Other promotions at Lunkenheimer include Charles McLean who has recently been promoted to personnel manager at Fairmount, and Frank Reilly has been made supervisor of employment.

Thompson

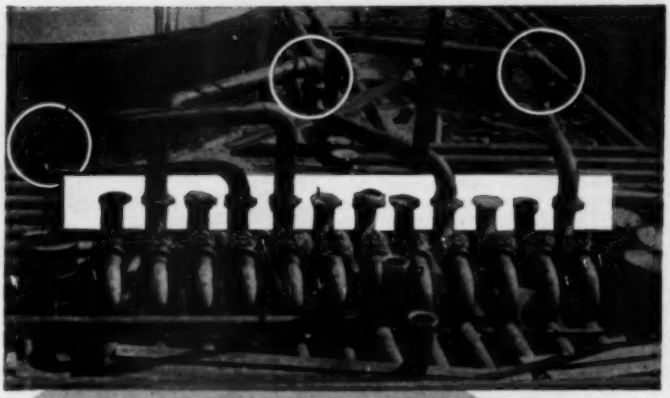
Southwestern Petroleum Elevates Three Executives in Election

Southwestern Petroleum Company of Fort Worth has elevated three top executives, naming J. F. Canning president. A vice president since 1941, J. W. Shugart, Jr., was elected executive vice president to succeed Canning. Orville H. Utley, who will continue to act as sales manager, was named vice president.

E. H. Beall, president since founding the firm 17 years ago, will continue as chairman of the board.

Goldsby Directs Export Division For Chicago Bridge and Iron

Fred L. Goldsby has succeeded W. D. Robinson, retired, as head of the Chicago Bridge and Iron Company's Export Department located in New York. A member of the organization since 1927,



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for transfer lines, terminal installations, manifolding, scraper box and jumper assemblies

• Switching from a blanking union to regular union is a simple, easy job with the WECO FIG. 208 Union. There are only two parts to remove . . . the wing nut and plug. Reversing the connection is just as easy and simple.

The Fig. 208 has less weight . . . less bulk . . . is easier to handle. All parts are interchangeable. The plug and male sub have an "O" ring to protect the metal to metal seal against corrosion and abrasion.

The WECO Fig. 208 has threaded ends . . . the Fig. 209 has ends bored for welding. Available in 3", 4", 6", 8" and 10" sizes. Ask your WECO Representative for details about the wide range of applications of the Fig. 208 Union.

WECO FIG. 208 BLANKING UNION

• Note the simplicity of the Fig. 208 Union and the ease with which it can be made up as a regular or blanking union.

Chiksan Ball Bearing Swivel Joints, (encircled) add greatly to the efficiency of this terminal installation.

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Goldsby has been in charge of the Foreign Erection Department at New York since September, 1947. He is a graduate of the University of Illinois with a degree in civil engineering.

New Managers, Chief Chemist Named At Sonneborn Plant

I. Silverman, former assistant manager of the Nutley, N. J., factory of L. Sonneborn Sons, Inc., has been appointed factory manager. Among others named to new posts, H. Riess becomes assistant factory manager and A. Moscowitz chief chemist. Announcement of the appointments followed the recent deaths of P. Dettelbach, former factory manager, and J. M. Kroth, former manufacturing supervisor.

MORE PLANT—Beckman Instruments, Inc., recently added another building to the 13 it already occupies in the South Pasadena and Pasadena areas in California. The newest plant, a modern glass and fieldstone unit similar to others in the Beckman group, will house the Personnel departments as well as a new Special Products division in which engineering and production facilities are centralized for the development of new types of instruments to meet special needs.

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SIZES: 3" and 4"
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in its improved hydraulic and cam design. Simple in operation, compact and sturdy, with a sliding sleeve that may be returned to vertical or semi-vertical position, to permit loading from either side of the rack.
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No. 450-A SPRING-MATIC returns upright automatically when raised to horizontal position, and incorporates other features of advantage to insure trouble-free operation.
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Matthews, Jeydel, Curry Wiech Join Celanese Chemical Division

The Chemical Division of Celanese Corporation of America has announced that W. D. Matthews has joined the Organic Chemical Department as a sales representative. Alan K. Jeydel and Michael J. Curry have joined the Product Development department as product development engineers, and G. H. Wiech as a technical service engineer. Matthews, a graduate of Stevens Institute of Technology, was formerly with the New Jersey Bell Telephone Company. Jeydel, who received a B.S. degree from Rensselaer Polytechnic Institute and a M.S. from Massachusetts Institute of Technology, was formerly with Pennsylvania Salt Manufacturing Company. Curry was an assistant professor at the College of St. Thomas, St. Paul, Minn., from 1948 to 1950 and recently was with American Cyanamid Company. Wiech, a graduate of Harvard College, was previously associated with Crucible Steel Company of America, Congoleum-Nairn Inc., and Heyden Chemical Corporation.

B&W Metallurgist Named to API Interim Committee Advising PAD

John J. B. Rutherford, metallurgist, Tubular Products Division, The Babcock & Wilcox Company, has been appointed a member of the Interim Advisory Committee on Alloy Steels of the American Petroleum Institute.

F. M. Porter, president of the API, stated that its assignment is "to secure adequate consideration of the industry's problems incident to conservation, substitution and essential uses of alloy steels as may be necessitated by shortages of alloys." Each member of the committee, an expert in his own field, and familiar with the needs of the industry, is to work informally with the Petroleum Administration for Defense.

De Laval Appoints Canadian Agents for British Columbia

The De Laval Steam Turbine Company has announced the appointment of Vancouver Engineering Works, Ltd., as their exclusive representative in British Columbia, Canada. Vancouver Engineering has been established in British

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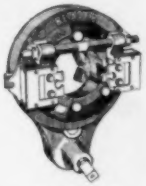
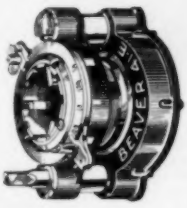
Beaver No. 104 Geared Squcre-end Knife Cutter cuts off square and clean without burr. Knives feed automatically — with safety guide ahead of cutting edge to prevent knife breakage. The No. 104 is ideal for cutting, grooving or beveling pipe. Furnished complete with operating ratchet.



No. 104

Beaver No. 41-E Geared Threader is fully adjustable for undersize and oversize threads of uniform length. Threads all sizes, 2½" to 4", with one set of dies! Fully-enclosed gear case! Furnished complete with operating ratchet.



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Research and Development Laboratories, Socony-Vacuum Corps. Author of "Modern Methods of Refining Lubricating Oils"

and **BERT ALLEN STAGNER, Ph.D.**
Consulting and Research Chemist; Member, American Institute of Chemical Engineers; Formerly: Supervisor Chemical Research, Union Oil Company of California; Research Fellow, Mellon Institute of Industrial Research

American Chemical Society Monograph, No. 63
Second Edition, Revised and Enlarged

The rapid development of petroleum technology has necessitated a revision of the original volume published in 1933. The newest practice in regard to treatment with sulfuric acid, tetraethyl lead, octane rating, etc., is described in detail. The present emphasis on all phases of this vitally important subject makes this book a particularly timely one, especially since the petroleum problem today is rather one of refining capacity than of crude production. For this reason technical improvements are of the utmost importance for the pressing problems of national defense.

CHAPTERS

Prefaces
Composition of Petroleum
Treatment with Sulfuric Acid
Sulfuric Acid Sludge and Hydrogen Sulfide: Recovery and Manufacture of Sulfuric Acid
Treatment with Alkaline Reagents
Sweetening Operations. Elimination of Elemental Sulfur, and Reduction of Total Sulfur in Light Distillates
Chemical Refining of Petroleum
Refining by Adsorption
Refining with Solvents
Detonation and Antidetonants
Inhibitors of Atmospheric Oxidation of Petroleum Products. Antioxygens
Gums and Cracked Petroleum Products
Deterioration of Lubricating and Similar Oils. Additional Agents
Supplementary List of United States Patents on Petroleum Refining
Appendix. Special Tables
Patent, Author, Subject Indices

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W-K-M Valves for process service utilize the proved W-K-M expanding gate design, which provides a smooth bore right through the valve. Only in W-K-M Valves are the gates activated by the Leverlock Cam construction which guarantees years of positive operation at any temperature or pressure within the range of the valve.

W-K-M Process Valves are in service in fluid catalytic cracking units, propane de-asphalting units, vapor recovery units, hydroforming units and refinery fuel systems.

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Colombia for the past 22 years, and is well known in all of western Canada for engineering and manufacturing ability. They will handle products of De Laval Steam Turbine Company, including centrifugal pumps, centrifugal blowers and compressors, steam turbines, De Laval IMO rotary pumps, speed reducers and flexible couplings. Specialized engineering projects and marine equipment will continue to be handled by the De Laval organization in Trenton.

Shell Chemical Corporation Names Keel Advertising Manager

M. H. Keel has been appointed manager of a newly formed advertising department in Shell Chemical Corporation. Born in Lethbridge, Alberta, Canada and a graduate of the University of Alberta and the University of Michigan, Keel joined the advertising staff of Shell Chemical in 1948. In his new position, he will direct Shell Chemical's advertising, publications and sales promotion program for agricultural chemicals, fertilizers, solvents, industrial chemicals and plastics. Keel's experience includes six years of research and operating experience in the chemical and petroleum fields and six years of advertising and publicity.

Keel

Instrument Sales To Represent Conoflow In Pacific Northwest

Instrument Sales Corporation has been appointed to represent Conoflow Corporation in the Pacific Northwest area, servicing Washington, Oregon and northwest Idaho with Conoflow pneumatic control equipment. The principals of the organization are Ray H. Branom, Victor Miller and Eugene Leeland.

Glass Engineering Opens New Los Angeles Branch

Glass Engineering Laboratories has opened a branch location in Los Angeles under the supervision of Robert Davis. The new location will distribute Glenlab specialized glass apparatus and Corning industrial glass piping and will maintain stocks of the piping and accessories.

Stephen May Represents Warren Pumps In Atlanta Territory

Warren Steam Pump Company, Inc., has announced the appointment of Stephen C. May as their Atlanta sales agent. May is a graduate of Georgia Institute of Technology and prior to becoming sales agent for Warren, served as vice president and general sales manager for Blackmer Pump Company. He is a member of the New York Engineer's Club, Atlanta Sales Executives Club and National Federation of Sales Executives.

Jefferson Chemical Names Bohle Assistant Manager

E. H. Bohle has been appointed assistant manager, sales department of the Jefferson Chemical Company, Inc., and will continue to direct the activities of Jefferson's commercial research division, a component of the sales department. Also, Dr. S. D. Koonce has been ap-

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100% Serrated Safety Grating by A. O. Smith

A. O. Smith 100% serrated safety floor costs no more than a plain surface floor. You get premium quality with *positive* safety protection—*at no premium in price!*

100% non-slip surface is assured when you use A. O. Smith Safety Grating. All bearing bars and cross bars are fully serrated.

Ask your purchasing agent, design engineer or safety director to get full details on this grating that assures maximum safety in any application.

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Screen Making
looks mighty simple

Screen Making—is simply a matter of making the right kind of openings of the right shape in the right arrangement in the right metal to fit into the well in the right manner so that the right amount of water can enter the pump bowl area with a minimum amount of resistance while holding back the sand formation. Outside of those details, the job is quite simple.

And the right kind of screen in a well is about as important as is the right kind of motor in an airplane. Fifty years ago, Layne bucked the screen problem and came up with something that hasn't been matched by any other manufacturer.

If Layne builds your water supply units and if sand screen is necessary, your job will have the famous Layne horizontally slotted screen. This means that your well will have a longer life, produce more water and operate on a lower cost than is possible with ordinary conventional screens.

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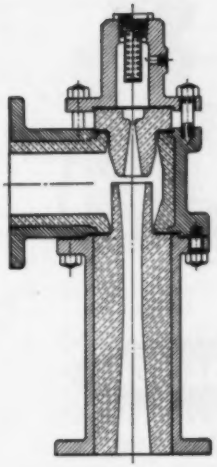
VERTICAL TURBINE PUMPS
WATER TREATMENT

C-R EVACTORS



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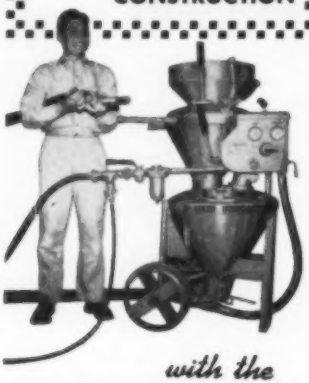

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Now Available ... to fit your needs.

Model #1000-S requires 100 CFM at 90 p.s.i.
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Both units can be operated from either plant air or portable air compressors.

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pointed market development manager in charge of the combined market research and market development divisions of the sales department. Koonce had previously been market research manager.

H. M. McIntosh Made Votator Division District Manager

Hewitt M. McIntosh has been made midwest district manager of the Votator division of The Girdler Corporation and will cover northern Illinois, Wisconsin, Minnesota, Nebraska, Iowa, North Dakota and South Dakota. McIntosh was born in Richmond, Va. He spent four years with the Army's Chemical Warfare Service before joining Girdler as a sales representative in 1945.

McIntosh

Bunn, Cartledge Appointed Carbide Division Presidents

Howard S. Bunn has been appointed president of Bakelite Company, and Thomas D. Cartledge named president of Linde Air Products, both divisions of Union Carbide and Carbon Corporation. Bunn has been vice president of Bakelite and Carbide and Carbon Chemicals prior to his present appointment. He entered the Carbide organization in 1922 as a salesman of alloy specialties for the chemical industry. After several years as an advertising writer he became advertising manager for Carbide and Carbon Chemical Company. Later he became manager of the Pyrofax division of that company. In 1938 he was appointed manager of the Plastics division of Carbide and Carbon Chemicals. In 1944 he was made vice president.

Ralph Werley Joins Sales Department at Jefferson

Ralph E. Werley, Jr., has joined Jefferson Chemical Company as a representative on its sales department staff. Werley, who received his B.S. degree in chemical engineering from Lehigh University in 1948, was until recently associated with Cities Service Oil Company.

District Manager Named

Appointment of a new district manager in the mid-central territory has been announced by the Hyster Company. The post will be filled by Wilton G. Smith, a veteran Hyster man who recently had been manager of the company's Washington office.

Chemicals Firm To Relocate

U. S. Industrial Chemicals Company, Division of National Distillers Products Corporation, has announced the relocation of its head office at 120 Broadway, New York 5, N.Y. The move does not affect the address of U.S.I.'s New York sales division offices.

Girdler Sets Up Canadian Office

The headquarters of Girdler Corporation of Canada, Ltd., have been established at Toronto, Ontario. J. F. Babbitt is the Canadian representative of the company, which is a subsidiary of The Girdler Corporation.

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Snyder Elected To Board

W. C. Snyder, Jr., president and chief executive officer of the Blaw-Knox Company, has been elected to the additional post of chairman of the board of directors.

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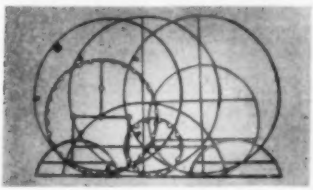

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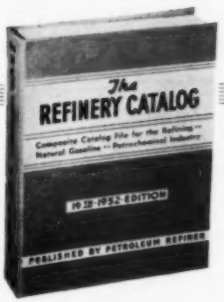

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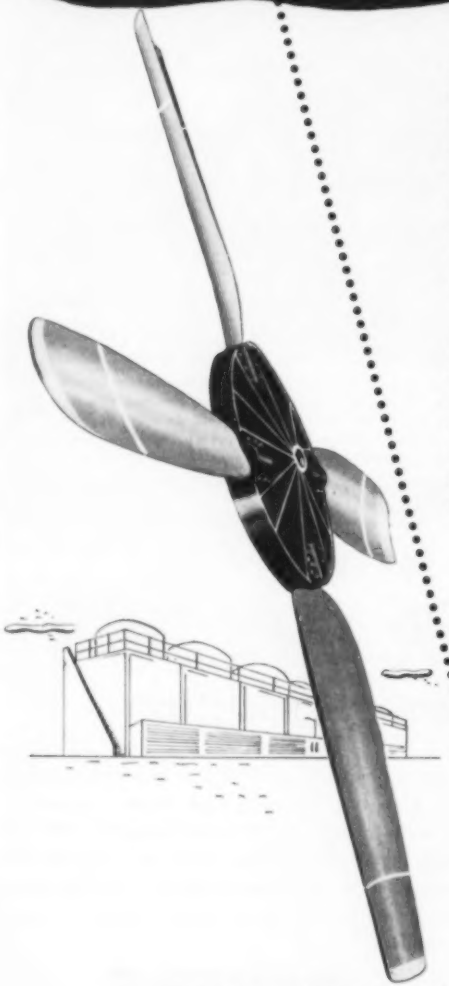

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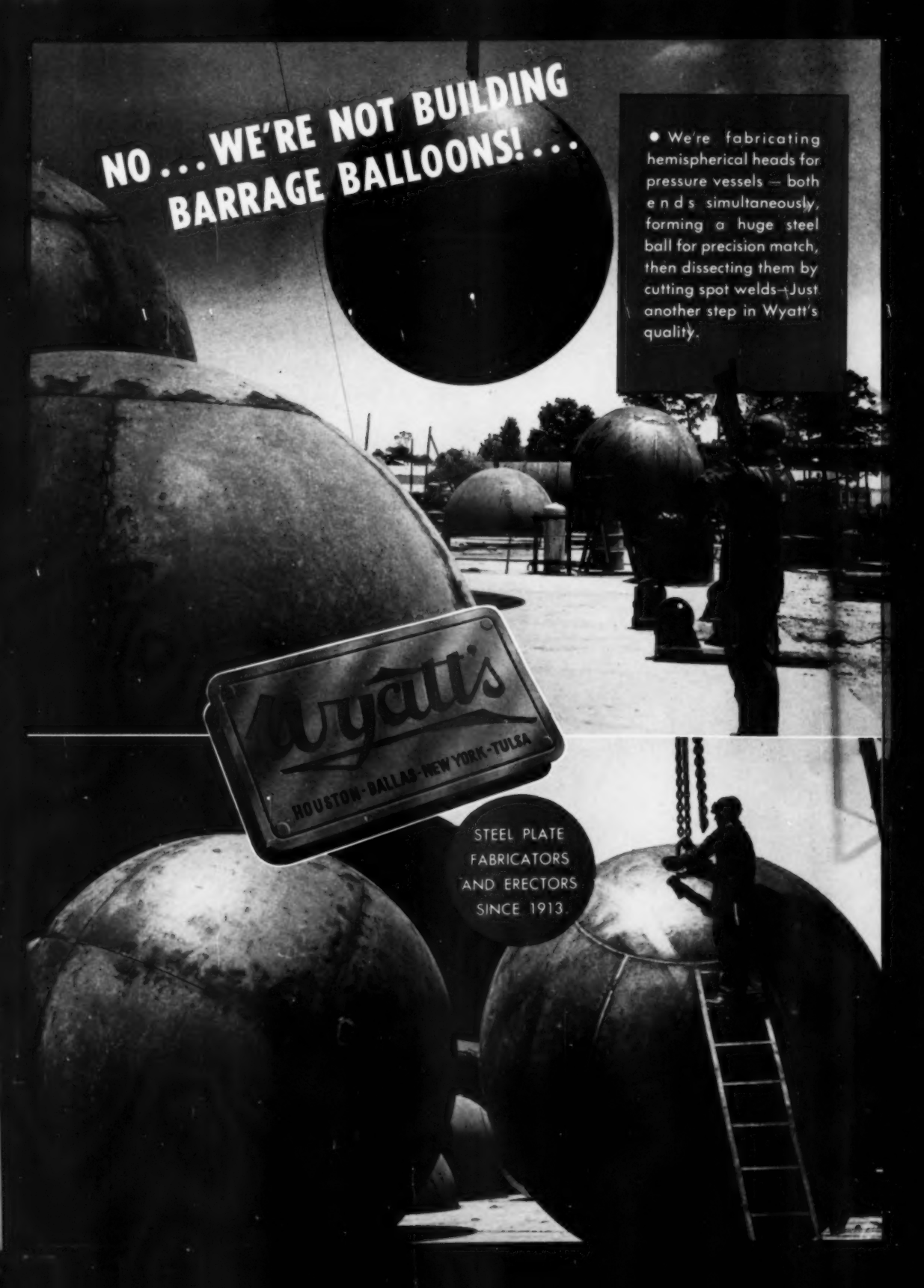
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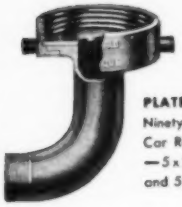

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